MODERN PRODUCTION MANAGEMENT SYSTEMS IN SMALL AND MEDIUM ENTERPRISES

- Barriers to their Adoption and Implementation

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Declaration

I hereby certify that this material, which I now submit for the assessment on the programme of study leading to the award of Master of Business Studies, is entirely my own work and has not been taken for the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

Signed: _____ Date: 10 Oct. '97

For my Family -

Mum, Dad, Derek & Dorothy

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Abstract

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by Daragh Killian

The use of a Production Management System is now widely accepted as one of the keys to manufacturing competitiveness. However, the current low level of adoption and successful implementation of such systems in small and medium Irish enterprises remains a pervasive and worrying problem. Following a review of the relevant literature on the introduction of Production Management Systems into Small and Medium Enterprises, intensive case data on fifteen companies and more extensive survey data on a further thirty representative of the main industrial sectors were gathered and analysed. The main barriers to adoption and use of Production Management Systems in Irish SMEs were isolated and examined, and the implications drawn for future research and practice.

Table of Contents

TABLE OF CONTENTS

CHAPTER TWO: METHODOLOGY AND RESEARCH DESIGN

CHAPTER THREE: CASE COMPANY PROFILES

CHAPTER FIVE: DISCUSSION OF SURVEY RESULTS

LIST OF DIAGRAMS

LIST OF TABLES

INTRODUCTION

"It must always be remembered that there is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system. For the initiator has the enmity of all who would profit by the preservation of the old institution and merely lukewarm defenders in those who would gain by the new one."

(Nicolò Machiavelli, *Il Principe*, 1513)

INTRODUCTION

In the manufacturing environment control of and timely use of information is crucial to the efficiency of a company's operations. From market forecasting through to devising the master plan to the final activities of production activity control and monitoring quality levels, the success and profit margins of a company are affected. Methods of efficiently managing a company's operations exist in the form of a Production Management System (PMS), and while the principles of PMSs have been in existence for some time now, advances are being made through the use of computerisation to make the process of controlling and managing the companies information faster, more integrative and more effective.

In any industrialised country, Small to Medium sized Enterprises (SME) play an important role in contributing to the countries economy. As the literature will show, they make important contributions in such economies as Japan, Britain and Ireland. Because of this importance, it is vital that SMEs flourish and prosper and do not fail in the short term. Thus management of this sector is crucial to this success. The use of PMSs in SMEs operations is one method of sustaining this level of management and control, yet there is evidence that the use of PMSs in this sector is at a low level, particularly in Ireland. It is the aim of this research to attempt to identify possible causes for this low usage of management systems, and provide a new light in helping efforts to address the problem.

The review of literature will draw on representative writings from the field of production and operations management over from the last twenty three years, on the topics of implementation plans for computerised information systems and advanced technologies into industry. But with the uptake of PMS still low after all of the attention received from this single area of literature, with many implementation models developed, effective implementation still remains beyond the grasp of many small

companies. Thus it was necessary to take a fresh view of the implementation process and cast the net wider and consider the implemnetation project from other viewpoints. It was realised that looking at the implmentation process from the point of view of a technological systems introduction was one dimensional, whereas the environment into which the system was being introduced was complex and multi-dimensional. This was addressed by turning to additional areas of literature that had useful insights into implmentation of systems into organisations. The area of managing change served to provide a new outlook on the political and organisational aspects of introducing new technology into existing environments, and the area of organisational psychology provided information on the socio-technical aspect of adoption by organisations and employees of new technologies into the workplace.

With this combination arose the conceptual framework around which the research of the literature could proceed and attempt to rationalise the barriers that were in existence to the effective usage of PMS in industry. Following the review of the literature, the method by which the empirical data was collected is outlined. In view of the fact that what was essentially being investigated were partially known phenomena, the approach that was decided to be most advantageous was that of a semi-structured interview technique. A sample frame was constructed allowing for all levels of PMS usage to be investigated - companies with no formal PMSs, companies that were struggling with their PMSs and companies that had succeeded with their PMSs. Five different industrial sectors were represented in these three levels of PMS usage, or categories, resulting in fifteen case study companies. To investigate the validity of the case study findings, a second data collection process was carried out by fax survey to over 150 companies. The methodology and research design chapter will expand on the research and data collection processes used in depth.

The resulting data and findings from the case company is examined closely to determine what factors are evident to suggest and identify barriers to the effective

implementation and adoption of PMS. The data was analysed under the thematic headings that emerged from the conceptual framework that was devised and developed in the review of the literature. It also discusses the nature of the case companies and their category representation, and the progression of the companies through the stages or categories to their present state. The finding from the survey questionnaire that covered areas such as types of production management systems currently in use and the barriers hindering their effective implementation and exploitation is discussed in the fifth chapter. As finally the conclusion for the research are presented with recommendations for further research.

CHAPTER ONE

REVIEW OF THE LITERATURE

1.1. INTRODUCTION

The operation of a manufacturing enterprise may consist of many complex activities ranging from product planning and market positioning right through to production monitoring and factory heating and lighting. Various tools exist to aid and create a successful method for the efficient management of a company's operations. These tools are collectively known as a Production Management System (PMS). The essence of a modern production management system (PMS) is to integrate all of the managerial aspects in order to provide a higher degree of control and feedback of the company's operations. It is with this higher degree of control that a company can avoid such problems as stock piling or stock-outs; with the higher degree of feedback the problems of bottlenecks, under and over production, and high levels of scrap can be eliminated.

However, uptake and exploitation of modern production management systems has, in the Irish context been disappointing low. This review of literature will show that this situation is not unique to Ireland, that it is an international problem. Over the last twenty three years there has been much written on the topic of implementation plans for computerised information systems and advanced technologies into industry. Included under this umbrella title shelters Materials Requirements Planning (MRP), Manufacturing Resource Planning (MRP II), Computer Aided Design (CAD), Computer Aided Manufacturing (CAM) and manufacturing simulation, to name a few. However, while much attention has been paid to the their introduction into a company's operations, with many implementation models developed, effective implementation still remains a problem. While the majority of the authors on the subject in the production management field have suggested the optimum route for Production Management Systems (PMS) introduction, few have documented clearly the

barriers that have again and again prevented the uptake of PMS. This section examines the literature from the field of production management that deals with these problems and the adoption and implementation of PMS.

1.2. PRODUCTION MANAGEMENT SYSTEMS

For the purposes of this research, the working definition of a modern PMS adopted is a management system that can be either manual, computerised, or both. It is a tool that in providing current and timely information, becomes an essential component for the smooth management and running of a modern factory. When you consider that in companies in the UK just 5% of company's information is held on computer, and only 1% on-line, (Financial Times, 1992) it becomes apparent that so much time and productivity is lost due to paperwork and manually monitoring and recording information.

The ultimate goal of a PMS is to have all company information integrated and on-line in order to reduce as much as possible the non-profit contributing elements of company administration and operation. A modern PMS provides a firm foundation for the implementation of an EDI link. The importance of developing EDI in the small competitive business cannot be overstated; indeed Culliton's (1991) recommendations includes the use of more efficient communications between companies using Value-Added Networks (VANS). This serves not only to increase the response time of the business, but also serves to reduce the impact of physical peripherality.

1.2.1. History of Production Management Systems

Computerised Production Management Systems began in the early 1960s when large manufacturers and computer suppliers promoted concepts and developed

software for production planning and control. The theoretical body of knowledge was inherited form operational research. The CPMS specialists focused initially on optimisation algorithms for batch sizing and scheduling, and subsequently on data management. Practical experience has shown that the issues were broader. The manufacturing system needs to be partitioned and controlled in line with overall business objectives. To affect commercial results, the implementation of CPMS had to be supported by changes in organisation, attitude and decision making practices (Waterlow and Monniot, 1986).

1.2.2. Benefits of Production Management Systems

The benefits of using a PMS can best be illustrated by performance figures of two independent surveys. While these surveys dealt purely with MRP, the advantages resulting from the successful adoption of MRP to yield these figures can be extended to a modern PMS. The first was a survey carried by Anderson, Schroeder, Tupy and White (1982) of companies in the American upper midwest; the second, a survey by LaForge and Sturr (1986) of small scale manufacturing industries in South Carolina

	Anderson et al.			*LaForge & Sturr*		
	Pre MRP	Current	Future	Pre MRP	Current	Future
Inventory turnover.	3.2	4.3	5.3	4.5	7.9	11.2
Delivery lead time (days).	71.4	58.9	44.5	55.6	41.7	31.8
% of time meeting delivery promises.	61.4	76.6	88.7	73.9	88.6	94.6
% of order splits due to unavailable mats.	32.4	19.4	9.1	29.0	13.5	5.5
Number of expeditors.	10.1	6.5	4.6	10.8	5.1	2.1

Table 1.2.2.1 - Average Operating Performance of MRP Firms.

As the figures show (table 1.2.2.1) there are significant benefits to be had from the adoption of an organised, formal, proven system of production management. This is also borne out in a survey conducted in England in 1990 by the Planning Research Centre in Middlesex, of 126 SMEs in the London area. They found that the "high growth" SMEs all had active strategies for managing production which included increasing control over and reducing production costs, seeking increased efficiency in the use and scheduling of labour, and improving and monitoring quality standards in production. (Smallbone, Leigh, and North, 1990).

1.3. SMEs IN IRELAND & THE WORLD

Defining Small to Medium sized Enterprises, SMEs, is not an easy task in that there is no universally accepted definition. What has emerged over the course of time have been independent national definitions for an international entity, all using employment and, in some countries, turnover as benchmarks. These benchmarks however have not ensured common understanding even at a national level with, for example, the UK Government using more than 40 different definitions for small firms in 1982 (Cross, 1983).

The Bolton Report (1970), when not invoking statistics as an explanation, found small businesses are easier to describe than to define. It described a small business as follows:

- In economic terms, a small firm is one that has a relatively *small share of its market*.
- It is managed by its owners or part owners in a *personalised* way, and not through the medium of a formalised management structure.

- It is independent in the sense that it does not form part of a larger enterprise and that the owner/managers should be free from *outside control* in taking their principal decisions.

The small firm's share of the market it is one that is not large enough to enable it to influence the prices or national quantities of goods sold to any significant extent. Personalised management implies that the owner actively participates in all aspects of the business and the decision making, with little devolution or delegation of authority. Independence from outside control rules out those small subsidiaries of larger companies or corporations who, while autonomous in many regards may still refer to the parent for major decisions, for example capital expenditure or plant modernisation.

In Ireland, the Industrial Development Authority uses employment as their benchmark to define the size of enterprises. Very small firms employ between 1 and 15, small between 16 and 50, medium between 51 and 200, and large employing more than 201. It must be borne in mind that these figures are based on establishment data and not company data; in other words a company with two manufacturing facilities employing 40 in each would be classified as a small company. In 1992 the European Union defined an SME in any member state as that which:

- is an independent business employing no more than 250.
- does not have a turnover exceeding ECU 20M, or:
- whose total assets (balance sheet value) does not exceed ECU 10M.

On the issue of independence, the EU expands on Bolton's constraint of autonomous ownership, allowing a company to remain independent in line with

their definition if no less than 75% of the ownership remains within the company (EC Commission).

SMEs play an important role in the economy of a country, in Ireland SMEs employ 83% of the workforce (Burns, 1989), while in Japan the 6.5 million SMEs, representative of 99.3% of the total number of establishments, account for 80% of the total labour force, and 68% of the country's GNP (Arai, 1990). Some of the strengths of SME include the fact that because they can react quickly, they play a vital role in innovation, as they do not suffer from bureaucratic inertia they may therefore respond quickly and with flexibility to the market demand shifts, and due to their size they have flat management structures allowing for good communication with fast response to problem solving and adaptation.

However, there are unfavourable characteristics which SMEs exhibit. They can be said to be inward looking, operating with a limited time horizon without clear long-term plans or objectives. Also, the SME owner-manager is often viewed as too close to the day-to-day running of the business, and the ambition to grow may often develop in an ad hoc under-resourced manner (Commission of the European Communities, undated). The survival of an SME is difficult because of their operating characteristics and the fact that a single decision can make or break a small business. Some of the internal problems in a SME may be classified under five main headings (Commission of the European Communities, undated). Some of these problems have the capacity to affect the adoption and use of computer aided management systems in the smaller company, while more could be eliminated by the implementation of a formal management system.

1. *Management Problems:* Lack of overall direction; lack of leadership; managerial incompetence; inability to cope with change; neglect of core business; lack of information readily available.
2. *Finance Problems:* Lack of financial control; poorly designed accounting systems; poor product costing.
3. *Production Problems:* Quality; inability to supply on time; inadequate use of facilities; high material wastage.
4. *Marketing Problems:* no product differentiation, delayed backup from production to the sales force on production capabilities.
5. *Human Resource Problems:* Staff spend little time planning; one man rule; little communication of data; lack of input across the board.

These may be compounded into one distinctive failing - that control over operations is the key missing element in many troubled SMEs. An SME that does not maintain control over its activities reduces it's chance of long term survival.

Burns (1989) found that in most cases owner/managers became satisfied with a "comfort level" that their foundling companies gave them, and because of this level of comfort with it's stability and independence their businesses do not grow beyond it. Stanworth and Curran (1976) argue that SME owners place a great deal of importance on this independence and the owners feel that embarking on a high growth strategy might lead to them feeling that their independence is threatened. This view is a difficult phenomenon to measure, but is none the less an important point to consider in attempting to identify the barriers to SMEs implementing a PMS.

1.3.1. The Use of Computer Technology in SMEs

Dennis (1990) found in his work on the influences of technology on small businesses in the U.S. that computers and communications technologies offer the flexibility that can provide SMEs with a competitive edge. This edge allows them to service relatively small markets with inexpensive goods of mass produced quality. Because, as mentioned earlier, SMEs have the ability to change rapidly as opposed to larger companies which experience difficulty handling fluctuation and significant change, SMEs should be the strongest in emerging industries. Dennis (1990) found that this advantage was not availed of as SMEs are not effectively employing the technologies they install.

In Andersson's (1990) survey of SMEs in Sweden and their application of computers, he discovered from over 850 interviews:

> *"that the PC is a support instrument rarely used in the technical function - the real business, just an office machine".*

The results he obtained back this up, with the majority of users utilising their computers for accounting and secretarial functions with very low usage for the production matters such as database queries, CAD/CAM, process control, production planning, materials control, and design calculations. This effect lessened as the size of the firms increased - linking the size of the firm to the usage of computer applications. In Japan the requirements of SMEs to deliver small lots of high quality parts, components and finished products with large variety, and deliver them in short production cycles to the market, has made them opt to extensively utilise sophisticated equipment. However their efforts to improve efficiency through the application of computer application only resulted in the doubling of their installations in the past 15 years while their larger counterparts increased installations by eight fold (Arai, 1990).

All of these findings - from America, Sweden and Japan, seem to agree that the low usage of computer aided management tools in SME is indeed a world-wide issue, and that through the non-use or mis-use of computer aided management tools, including PMS, a competitive advantage is being lost. As the literature shows, SMEs need to avail of every possible advantage to compete successfully against the larger companies. They must therefore seriously address the problem of PMS implementation and use.

1.4. THE DEVELOPMENT OF THE RESEARCH FRAMEWORK

1.4.1. The Need for a New Approach

The basic fact that emerges from the bulk of the literature is that SMEs should adopt effiecient production management systems into their operations. There has also been extensive attention given to the implementation of a PMS into a company's operations in the production and operation management and information technology spheres of literature (for example: Wight 1981, Landvater 1981, Metzger, 1984 and Roa, 1985). But while this subject of systems implementation has been documented over the past thirty years or so, the question remains why does recent research (Andersson, 1990; Arai, 1990; Dennis, 1990; etc.) still maintain that SMEs are not successfully using modern PMSs in the everyday running of their operations.

Perhaps the problem lies in the limitations of examining implemtnation issues through the PMS literature alone. Since this research was specifically intended to explore the organization and managemnt issues associated with the adpotion and implemetnation of modern PMSs, the conceptual framework for the study was deliberately extended beyond the traditional PMS field. The literature on organization and managemnt was also examined for additional insight into the processes involved. The two areas that were deemed to be most relavant in

promising to the task at hand were the managemnt of change literature in the management field and the introduction of new technology literature in the organizational psychology field.

Because each of these three fields are addressing a common problem in an attempt to resolve it to a common goal, there will be aspects of each which overlap and impinge on each of the others. Figure 1.4.1.1 illustrates the interaction of these fields of knowledge. Each field approaches the problem from a different direction: production and operations management from a technical perspective, the management of change from a political perspective, and organisational psychology from the social perspective.

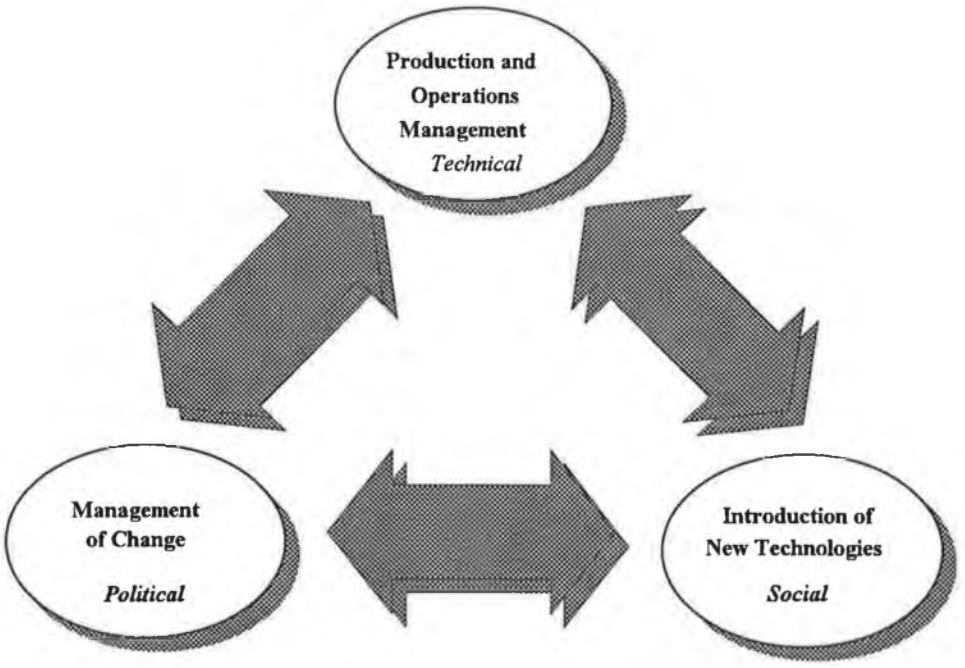


Figure 1.4.1.1 - The Research Framework.

Lockett, Barrer and Tanner (1989) agree with this approach, having found themselves that existing "best practice" MRP methodologies cited in the production and operations management literature do not deal explicitly with

factors such as the organisation, it's structure and people, and the antecedents of previous change processes. They found from their research of SMEs in the UK that there was evidence that the success of the implementation of Materials Requirements Planning, MRP, into a company is largely dependant on the organisational and historical factors of the company - to a much greater extent than has been previously published.

1.4.2. Production & Operations Management - *Technical Aspect*

Much attention has been given to the implementation of PMS into companies in this area of literature. But rather than discussing it in a broad fashion, the trend has been to systematically break the implementation of a system into distinct steps, in a logical progression to "system success" (Wight, 1982; Landvater, 1981; Bruckler, Flowers and Peck, etc.). This approach may have stemmed from the technical nature of the journals and the desire to devise a single strategy as a solution for PMS implementation. It is in this area that some of the plans and stepped sequences have their weaknesses, in that what may have been written for the high volume, process industry may not have the "best fit" for the smaller job shop environment.

White, Anderson, Schroeder and Tupy (1982) in an extensive survey in the American mid-west found much evidence of implementation failure. From their study, we can see what the predominant reasons for MRP implementation failure were ten years ago in 1,700 small manufacturing companies in this region. While the survey dealt exclusively with MRP, the problems which would have been encountered in these cases would bear sufficient similarity to be of direct relevance to our research. In their survey they classified seven main reasons for failure (Table 1.4.2.1).

Major Problem	Percent
1. Education of personnel	23%
2. Lack of top management support	20%
3. Implementation approach (lack of time, personnel)	15%
4. Problems with MRP system (lack of technical expertise)	15%
5. Gaining acceptance	11%
6. Inventory control & record accuracy	9%
7. Forecasting Demand	7%
Total	100%

Table 1.4.2.1 - Problems Encountered During MRP Implementation.

The problems which they found have been supported and examined in a range of other studies. For example, Duchessi, Schaninger and Hobbs (1989) from their work on the implementation of a computerised PMS by firms in America were able to identify key factors that had an effect on the success of PMS adoption. Of the 4,770 companies surveyed, they received 352 (7%) replies, of which 272 had implemented and operated computerised PMS. They cited four areas as constituting the main problems preventing in the introduction of PMS into their operations

1. Top Management Support.
2. The Implementation Process.
3. Software and Hardware.
4. Guidelines for Top Management.

From studies and work such as these, it is possible to analyse the various factors into key areas of direct importance to this

1.4.2.1. Insights into the Implementation Process

There have been many implementation routes put forward by authors and researchers over the course of the usage of MRP and MRP II. While it is recognised that an MRP system does not constitute a PMS, it is true to say that the problems encountered during it's implementation into the production environment - especially into SMEs, would be similar to a PMS. This section outlines some representative samples of PMS implementation routes. The dominant method of these routes have been the steps form, rather than phases, with the steps representative of individual goals that are to be achieved in a systematic, ordered fashion.

Metzger (1984), in his work on MRP II implementation cites several angles of attack by which to a company's MRP II system may be adopted successfully. One of the first recommendations that he advocates is the use of a modular approach to the adoption of a system. Using this approach helps absorb the initial shock waves that become inherent in any change to the work environment. It also serves as a path to create the various building blocks that can then locked together as the system develops, the prime building block being the engineering data base, as this will be the residence of all the company's static and dynamic data. The modular approach will allow the system to succeed in a situation where the existing system is firmly entrenched. As mentioned earlier in this review, Metzger advises an order of implementation of the various modules of the MRP II system that would be most beneficial in replacing existing manual and semi-automated systems with on-line support. In order of decreasing priority: Engineering Data Base, Stores control, Materials Requirements Planning, Shop Floor Control, and Master Scheduling.

As the implementation process is essentially a project that has to managed effectively, it can be divided on to four distinct stages, or phases, that will occur in a progression through the projects completion (Martin, 1976). Although some of these stages will undoubtedly overlap, at any one time, one phase will be predominant. These four phases are:

1. The Concept Phase.
2. The Organisation Phase.
3. The Operational Phase.
4. The Completion Phase.

To these four distinct phases Roa (1985) applied the implementation process of a computerised PMS. In the concept phase, the management makes an initial commitment to the project, this commitment may have been triggered by such factors as poor customer response, inventory levels running to high, etc. The factors that the management considers here are the software and hardware costs, education, consultancy, and reassignment/expansion of manpower.

The organisation phase deals with the establishment of the project teams and the appointment of the project leader in such a manner that will ensure a smooth management of the project. The other criterion that the management considers at this phase is the establishment and implementation of controls that will be invoked on the implementation project. These controls include the reporting interval of the project team to senior management or the appointed steering committee; the setting of target goals and the target dates by which to meet them; the project costs and budgets; and the extent of authority the project team may have in implementing the system.

The implementation plan is the final step in the organisation phase. It is at this stage, with the organisation structured and in place, that the project team may begin the implementation. Rao divides the implementation plan into five stages:

education, documentation, testing, modular implementation, and detailed Cost Benefit Analysis (CBA). Both Rao and Metzger agree on the need for supporting system documentation which should be updated regularly and adhered to as system policy. For this to work successfully, the documentation needs to be unambiguous, quickly accessible, and clearly written. Rao suggests the appointment of the system trainer with the responsibility of the constant updating and referral of the system documentation. This allows for any unanswered questions and new system technical developments.

The testing of the system is essential to the system success, but only when the testing procedure is designed and carried out in a structured manner. Ill conceived tests give the user a poor system, Rao states, it is thus important for the user to be involved in the tests. According to Rao, there are three different methods of starting a system, one he recommend, the others he dismisses as unsuccessful. The successful method is that of the pilot test approach, testing the system at initial start up using a few items or products; if successful, the system may then go live with all items. The two unsuccessful tests are cold turkey - the immediate shut down of the old system and switching to the new, and the parallel approach - running the two different systems side by side in the same plant.

On the issue of modular introduction of the system, Rao differs with Metzger with regard to which should be the implemented first. He believes that inventory control and bills of materials, each with a minimum 95% accuracy, should be implemented before the data base module. He warns of companies taking the short-sighted approach and attempting to implement first the modules which directly influence their immediate problems, this lays the groundwork for eventual failures. Top management should carry out and analyse a detailed Cost Benefit Analysis (CBA), not only to aid in the project budget and project's

initial costs, but also to allow them to examine their cash flow projection and the financial benefits to be reaped from the implementation of the various modules. This will then allow them to chart the company strategically through the entire system implementation process while reducing it's financial exposure. The next two phases, operational and completion phases, should in the perfect world be purely monitoring phases, due to the fact that if the two preceding phases were carried out successfully, the groundwork for success has been laid.

1.4.3. The Management of Change - *Political Aspect*

"Change is not made without inconvenience, even from better to worse."

(Richard Hooker 1554 - 1600)

Change, by definition in the Oxford dictionary, is the act or an instance of becoming different, an alteration or modification. All enterprises pass through distinctive phases as they form and develop. However, as they develop through each stage, the change is often accompanied by a crises which may be either internal or external to the business. An enterprise's development clearly involves the successful management of change. When a company decides that it will implement a new PMS, it is about to embark on a voyage of change - change of the company's operations, change of the company's employee's job specification, change of the company's approach to situations, and possibly even change to the company's suppliers, customers and market position. If this change is misunderstood, mismanaged, or simply ignored as a success variable, even the most carefully planned implementation plans have a strong chance of failing. It is therefore important to pay careful attention to the whole subject of change, it's management and the components of the change process.

One of the areas in which the change literature can prove useful is in the insight that it provides into the relationship between decision and action. Brunsson (1982) argues an important point concerning the relationship - that action does not automatically follow decision making. These two processes are often different in nature as his model illustrates (figure 1.4.3.1).

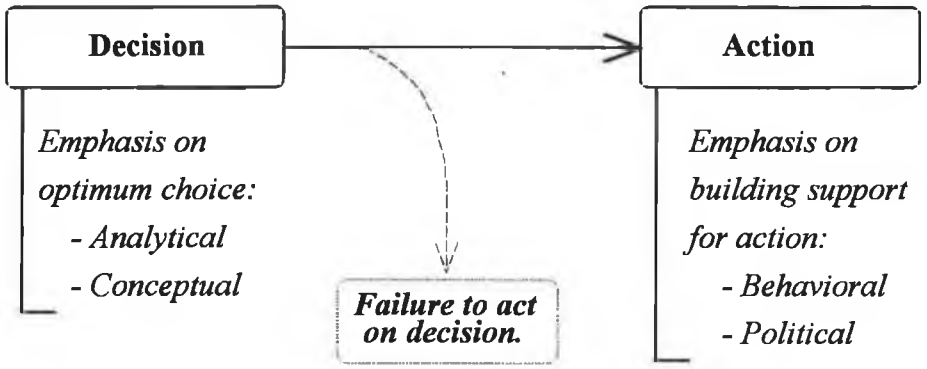


Figure 1.4.3.1 - Modification of Brunsson's Decision-Action Theory.

Brunsson does warn that one cannot seek to provide managers with better decision models to help them improve their effectiveness and just leave it at that. It is important that they better understand the processes by which decisions are turned into effective action, through positive propaganda, support building and other measures designed to actually mobilise bias in favour of the chosen system or course of action. These are essentially behavioural and political activities that are often neglected in the PMS literature, with too much attention being paid to models designed to yield optimal technical solutions and not enough to the process of making the chosen decision or system, whatever its shortcomings, work.

Peters and Waterman (1982) found that a desire for activity can lead to inactivity and inaction, and that the search for and application of a rational

model can happen to such an extent that action stops and planning runs riot. This perspective has something to offer the more mainstream PMS field in relation to such areas as lack of top management commitment, the importance of project champions or leaders and the need for organisation wide education and continual commitment building activities in the initial stages of system implementation. By introducing a system into an organisation there is going to be an inherent change occurring from within, the overall success of the new system will depend on how the organisation responds to the change pushed upon itself.

Brunsson (1982) raises a valuable point in that an organisation must questioning itself as to why it must change from it's current system to a new position. The ramifications of the answers to this question and thus determining the need for change is what will initially spark off, even subconsciously , the adoption of a system. Even by clearly defining the desired future state has succeeded in giving the company a jump start on the road to the selection and adoption of a system. Secondly what is serves to do is to give the company fixed target goal, a target to aim for in the action plan and company business plan.

In his extensive work in the area of change and social behaviour Lewin (1951) argues that a change process should involve three distinct steps. What this suggests is that before a new behaviour can be successfully adopted, the old one has to be discarded, and assumes that the will of the change adopter (the subject of change) will be important (Burnes, 1992). Lewin's three steps comprise his model of change which are composed of unfreezing, moving and then refreezing the system, as illustrated in figure 1.4.3.2.

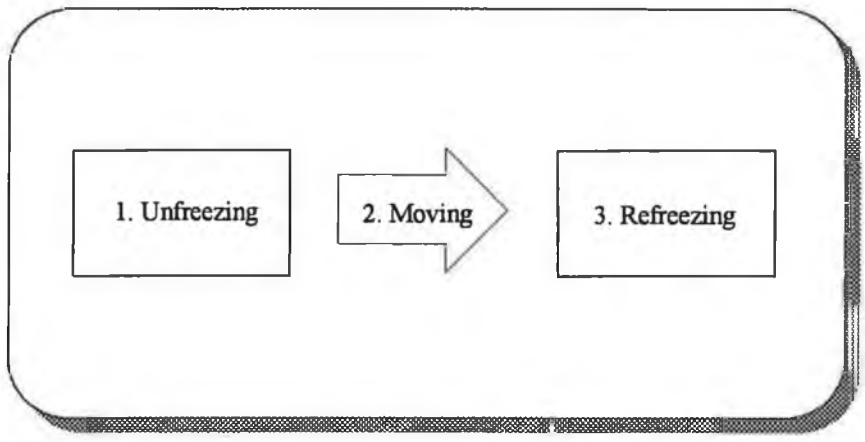


Figure 1.4.3.2 - Lewin's Model of Planned Change.

Bell and Burnham (1987) renamed these phases preparing for change, implementing change, and stabilising the change. It is at the first stage, that of unfreezing, that management must create the awareness for the need for the change, create momentum and ensure commitment and drive form everyone towards the attainment of the new process. In Fogarty, Blackstone and Hoffman's (1991) review of the second phase, implementing the change, they list seven questions that should be addressed that will ultimately impact the adoption of the change in a selected area of a company's operations:

1. How vital is the system or area?
2. How effective is the present approach, method, or system?
3. What are the expected costs of people hours, equipment, and software, to implement change?
4. What are the expected benefits of the change?
5. What is the probability of a successful change?
6. How long will it take to complete the study and implementation phases?
7. Can the organisation make the study and carry out the likely change recommendations?

The third and final stabilising phase requires full acceptance of the new policies, methods, and procedures of the new system. Important at this stage is the monitoring and minor adjustments to ensure that the result of the change

process is a profitable one. Refreezing seeks to stabilise the organisation at new state of equilibrium in order to the make sure that the new practices and ways of working are safe from regression back to the practices prior to the unfreezing phase (Cummings and Huse, 1989).

Bullock and Batten (1985) in their review of over 30 different models of change process, extend the three step phase that Lewin developed into a more encompassing four step process. These phases include the exploration phase, the planning phase, the action phase, and the integration phase. This process is represented in figure 1.4.3.3.

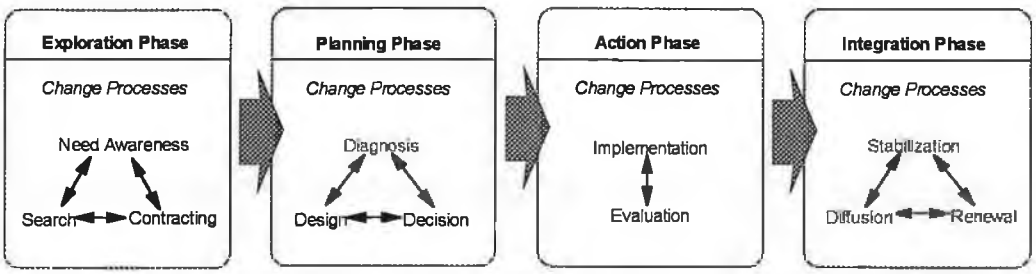


Figure 1.4.3.3 - Integrative Model of Planned Change

The exploration phase is the stage at which the organisation decides whether it wants to plan for specific changes and commit it's resources to the planning effort. The planning phase deals with the organisation coming to terms with the problems that the organisation is facing and planning the changes necessary for their resolution. This phase ends and the action phase begins when key mangers approve the proposed changes. The action phase is the implementation of the changes required, during which transitionary time the change activities are

evaluated periodically to assess their progress and effect. Once the changes have been implemented the last phase, that of integration, involves making them part of the normal organisational functioning. A necessary aspect of this change is stabilisation, whereby the introduced and assimilated change can function without reliance on external assistance.

1.4.4. Organisational Psychology - *Social Aspects*

Over the years considerable attention has been given to the role of psychology in industry. More recently, attention has focused in the field of psychology on the area of Advanced Manufacturing Technologies (AMT) and their implications in the workplace. Among the advanced technologies that research has been carried out on in this area, has been computerised management system and computer based information systems. The range of this attention has been in the measurement of attitudes towards the technology, the effect of the technology on the social aspect of industrial society, and the paths of implementation of these technologies into industry. In the late 1970s there existed a train of thought that presumed that the key task of management of new technologies was to devise ways how to encourage people to adapt to new technology, rather than how can the technologies be adapted to the needs of the user (Blackler, 1988). To some degree this carried into the 1980s when the expectations about new technology was that it would be sufficient to merely buy and install the new equipment.

Davis, Bagozzi, and Warshaw (1989) found that many authors tried to address the issue of adoption (e.g. Alavi and Henderson, 1981, Nickerson, 1981, Swanson, 1988) and all found that the end-users are often unwilling to use the available computer systems that would generate significant performance gains

to the company. Patrickson (1986), also addressed the problem of adoption to new technologies and the negative impact associated with the introduction of computer based technology. Swanson (1988) stated that understanding why people accept or reject computer technology has proven to be one of the most challenging issues in information systems, (while Swanson was addressing computer technology and usage directly, the usage of computer technology has an obvious direct effect on the exploitation of computerised PMS.) and their eventual efficient operation. The area of organisational psychology helps to tell more about why this happens.

If we look to the area of organisational psychology, we find again a model that strives to explain an introductory process; in this case the acceptance and utilisation of New Technologies. Modern PMS are considered a facet of new technologies, and much of the work carried out on new technologies has direct relevance to the type of production management we speak of here. Hurley (1992), addressing an earlier work (1990) which recognised the need for empirical work to explore the relationship between empathy, collaboration and management of new technologies in organisations, developed a model (figure 1.4.4.1) drawing on existing literature to explain the sequence of processes related to the introduction of new technology in a company.

The Hurley model and the Wight (1981) model come from different perspectives, but have many similarities. Clearly the insights to be gained from the approach of the organisational psychologists to the introduction of the new technology should prove of some benefit to us in our attempt to understand the barriers to effective PMS adoption and exploitation.

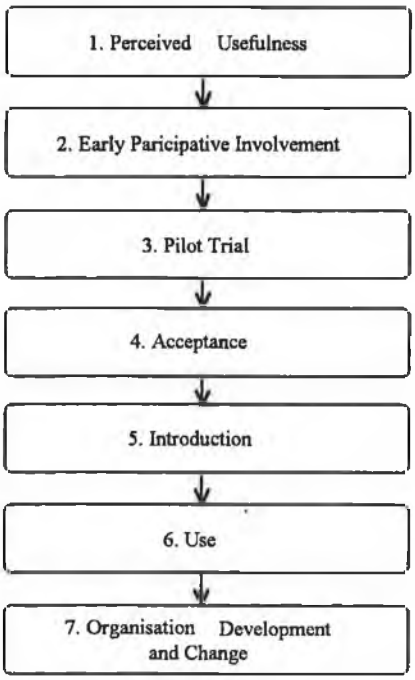


Figure 1.4.4.1 - Process of Introduction of New Technology.

In work carried out by Blackler and Brown (1986), they refer to alternative models which serve to guide the design and introduction of the new information technologies into work organisations. They discuss a suggestion that an emerging 'paradigm change' can be said to be influencing systems engineers. This change involves an evolutionary, use-centred employee supporting perspective instead of the conventional static, program-centred and employee-replacing one. In their article they present two models - each with the same four 'phases' of information technology acceptance. These two models are:

1. Task and Technology approach.
2. Organisation and End-user approach.

What differs with each of the four phases in the two models are the guiding premises, key actors, and work organisation issues. The four phases are:

1. Initial Review - *initial recognition of possible opportunity.*
2. Exploration and Prior Justification - *analysis, feasibility, review, recommendations.*
3. Design of System - *design operationalization and detail or 'off the shelf' choice.*
4. Implementation - *construction or installation, trail, operation.*

There has been considerable attention in this field given to the person-technology (the socio-technical) interaction, an important point in promoting the acceptability and useability of any new technology. Blackler (1988) summarised his findings of how the focus was changing with regard to the implementation of computer technologies into the workplace:

There should be a change in focus.....

...away from a concentration on computer automation	⇨	towards attention to human computer interaction.
...from thinking of information technologies as tools	⇨	to thinking of them as patterns of social relations
...from relying on the rationality of participants to steer IT applications	⇨	to an understanding of the importance of organisational politics
...from concern with cost reductions through automation	⇨	to a concern with added value and organisational benefits

1.5. IMPLEMENTATION SUCCESS AND FAILURE - FACTORS FROM THE LITERATURE

When the combined literature is examined from this perspective it yields several themes which serve to address many of the problems that literature identified as barriers. It is seldom that the adoption of a system would be halted or abandoned due to one of these barriers solely, it generally is the case that the implementation fails due to a combination of reasons. The processes of adoption and implementation of a PMS are clearly complex and the ways in which they can go wrong varied and diverse. What is therefore needed is deeper understanding of the factors involved, and how they interact, which is the primary focus of this study. Figure 1.5.1 presents these factors which will be dealt with in detail.

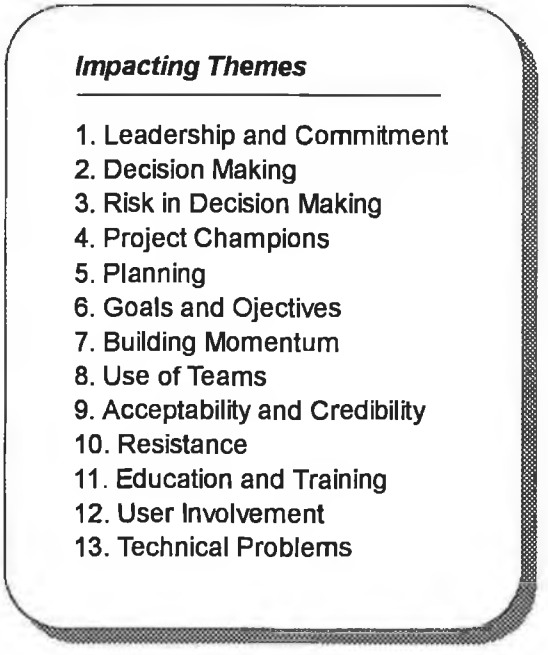


Figure 1.5.1 - Impacting Themes from the Literature

1.5.1. Leadership and Commitment:

While the studies of Wortmann (19) and White, Anderson, Schroeder and Tupy (1982) mention the lack of top management support as a prime reason for

implementation failure, it must be noted that this problem is not just confined to the top level of management in a company. Indeed support must be given by all levels within the organisation who are in an influencing position. This extends to foremen and secondary users. This was confirmed by Cox and Clark (1984) having conducted questionnaire surveys to quantify the level of management commitment to systems implementation. Kneppelt (1981), in his work on MRP implementation, also found and listed many management problems, the most important of which includes lack of top management commitment, procrastination by management, and a lack of involvement by supporting departments. He differentiates between simply having management support in starting the project and the need for continuous support throughout the project's life. Beatty (1992) in her work on systems implementation, remarking that periodic expressions of interest and support plus protection from other executives appeared necessary. She remarks that top management support was necessary and important to get the project going, but not necessarily to energise it during implementation.

On the subject of the picking of a project leader, Wight (1981) cites three mistakes that are most commonly made in the picking of a project leader. These are:

1. **Using a systems person:** Wight feels that the right person here should be a user, and not a systems person, for the reason of accountability. No one in the systems area can be responsible for the making the system work after it's gone live - only a user can do this. This point however may have changed with the evolution of software and attitudes.
2. **Using an outsider as the project leader:** According to Wight the myth that bringing in a person from outside the company to implement the system is the best route is false. The best person to use can be a manager within the

company that has a thorough existing knowledge of the company's products, operations, history, problems and people.

3. **Trying to use a part time project leader:** When a project leader is not full time, the MRP II installation can drag on for a long time. The result will be that the company will find itself fire fighting rather than tackling the source problem in a fire prevention manner, i.e. the successful installation of the system.

1.5.2. Decision Making

The introduction of any change into an existing process requires a decision to be made to initiate this change by someone. Eilon (1969) defines a decision as:

> "a moment, in an ongoing process of evaluating alternatives for meeting an objective, at which expectations about a particular course of action impel the decision maker to select that course of action most likely to result in attaining the objective."

This suggests two salient points: for a decision to be made there must be an alternative, and information must be necessary to arrive at those alternatives. This decision process will have a direct effect on the direction that the change will take within the system. There are many parameters that affect the reaching, implementation and action of this decision; these will be dealt with later in this section. It becomes logical to presume that the larger the level of change required the stronger and more radical a decision that will have to be made. It is therefore understandable that the in the case of a large change process, decision makers will approach the problem with more care, thought - and in some cases - more reticence.

Pfeffer (1992) discusses the process on decision making and offers an alternative perspective on it. He remarks that many decisions "fizzle before producing any results", and coins a phrase 'implementation science' agreeing

with Brunsson in that a decision by itself changes nothing. No matter what an individual or a company decides what to do, the decision itself will change nothing, implement anything, or initiate anything. Also the decision quality cannot be judged until the results of the decision's implementation have become known. This may be by actuality, decision modelling, or simulation. Most important is the fact that people spend more time living with the consequences of decisions than they do making them.

> "The effects of the decision will be with us longer than it took to make the decision, regardless of how much time and effort we invested".

Clearly Pfeffer believes that more emphasis should be given to the implementation of decisions and dealing with their ramifications, rather than simply the process of decision-making which has been over-stressed.

1.5.3. Risk in Decision Making

Most decisions on the adoption and implementation of new PMS carry uncertainty and insight. Barton and Bobst (1988), argue that this risk can be classified into three distinct categories.

1. Business Risk
2. Organisational Change Risk
3. Project Risk

Project risk they further divide into three factors: size, technology experience, and project structure. Work by Hottenstien and Dean (1992) identifies four possible sources of risk in the implementation of AMT into a company: market, strategy, technology, and organisation risk; however while these works comment extensively on the existence of decision risk, they do not suggest how the exposure and effects may be lessened. Rather good managers should be

skilled in managing the consequences of their decisions and coping with the resulting risk, quoting from Richard Nixon to reinforce this point:

> "Few successful leaders spend much time fretting about decisions once they are past."

1.5.4. Project Champions

"A new idea either finds a champion or dies."

- Donald Schön (1963)

A variable that has proven to have a very strong link with the success of technical innovations, and the adoption and implementation of a new technology or operating practice, is that of the presence of a champion (Howell and Higgins, 1990). Schön (1963) defines a champion as "an individual who informally emerges in an organisation and makes a decisive contribution to the innovation by actively and enthusiastically promoting its progress through the critical organisation phases." He proposes that for resistance to an innovation within a company to be broken down there must be a champion. This champion must identify the idea as their own , promote the idea actively and vigorously through informal networks, and risk their position, credibility, and stature in the company to ensure the success of the innovative or technical idea.

Beatty's (1993) first rule is that for the implementation of a new technology is that a skilled champion is required. Her research showed that companies that were lacking an effective technology champion found that implementation proceeded more slowly and did not achieve their objectives. Under the broad title of 'champions' and the individuals involved in the innovation process, Howell and Higgens (1990) found there to be five roles:

- *Gatekeepers,* who translate and distribute of external technological knowledge and advancements to their colleagues;

- *project champions*, who distil creative ideas from information sources and enthusiastically promote them within the organisation;
- *business innovators*, who provide support, access to resources, and protection from the interference within the organisation as innovations emerge;
- *technical innovators*, who design and /or develop the innovation or new technology; and
- *user champions*, who implement the innovation or new technology by training and providing assistance to the users.

Buswick (1990), describes what he sees as being the inherent qualities required of a champion as: expertise, credibility, planning skills, networking skills, sensitivity, objectiveness, tenacity, decisiveness, assertiveness, and confidence. On the subject of expertise, he argues that to be a champion, one must have sufficient knowledge. He reasons that

> "A technology expert who's doing training is a better candidate for champion than a trainer who's working to learn technology."

Credibility is having respect from co-workers and superiors - an ingredient essential if the champion is to motivate and instill loyalty into those around him. Having both an internal and an external network is of value to gain the backing, support, and timely information when attempting to implement the change in to the company, along with the tenacity to pursue the project goal despite setbacks and barriers. The use of influence as a tool used by champions is reported by Schön (1963) as them being 'capable of using any and every means of informal sales and pressure in order to succeed'.

Champion failure can occur due to lack of the implementational skills, which are persuasion, motivation, networking, communication skills, and political skills. Beatty (1993) found that most of the failed champions were from a purely

technical background and had never had been in line management positions. What logically followed from champion failure was lack of top management support, therefore sounding the death knell of the project. Beatty found that champions will not work well within an autocratic system or in the absence of team experience or training. Conflict with the team and the champion may also cause problems.

1.5.5. Planning

The one abyss into which a company may fall very easily is that of instigating a major project without any formal planning or foresight. Wight (1981), Landvater (1981), Roa (1985) and others all stress planning as critical to the implementation of a successful system, and that failure to plan and allow for the multiple aspects necessary for full system implementation results in the implementation plan falling apart. Cox and Clark (1984) have attributed numerous failures to a lack of prior planning, and not including the education and communication needs in the project forecast and plan. Kneppelt (1981) ties lack of project management and poor planning together, resulting in the implementation process being more likely to proceed on intuition rather than on a structured, well defined path and will almost certainly lead to implementation failure.

The lack of planning may manifest itself in many ways, be it technical, organisational, financial, or otherwise. Rao (1985) advocates that top management should carry out and analyse a detailed Cost Benefit Analysis (CBA), not only to aid in the project budget and project's initial costs, but also to allow them to examine their cash flow projection and the financial benefits to be reaped from the implementation of the various modules. This will then allow

them to chart the company strategically through the entire system implementation process while reducing it's financial exposure.

1.5.6. Goals and Objectives

When a company clearly defines a desired future state it has succeeded in giving itself a jump start on the road to the selection and adoption of a system. This goal becomes a target to aim for in the action plan and company business plan. Goals and objectives[1] also serve to impart a "strongly shared vision or organisational culture" (Pfeffer, 1992). In the attainment of any project there are both short term and long term goals and objectives. This is an important distinction, and there has been attention paid to both types.

Beatty (1992) states that projects concerning the implementation of new technologies should have goals that should be realistic, clear, communicated, accepted throughout the organisation, and most importantly - targeted not at short term payback but at improving the company's competitive positions. More importantly she also discusses the setting of *achievable* goals and working towards each goals attainment. One of the mistakes that she found form her research to be most apparent was that many of the companies set a short term financial goal on the technology, and were disappointed by the results. On the other hand, those companies that invested in technology with a goal of improving their market positions were more likely to have clearer, more specific, more challenging and as a consequence - more motivating goals than these companies which tended to focus more on the short term financial gain. These companies that had this motivated approach tended to be the most successful companies at the adoption of the technology.

[1] There is little distinction made between goals and objectives in the related and consulted fields of literature. For the purposes of this work they are taken to have equal meaning.

1.5.7. Building Momentum

Motivated companies tend to be the most successful companies of those who adopt new technology (Beatty, 1993). It is important that momentum is not only created but keep alive in the pursuit of project goals. Howell and Higgins (1990) advocate inspiration by management and strategically placed people in an organisation to invoke persuasive images and to enhance confidence and motivation in the pursuit of project goals. Metzger (1984) agrees that the building of momentum is crucial for success of the implementation of a system. Once a system has been successfully implemented, social barriers seem to break down as people tend to ride on the bandwagon of success (*sic*). Because of this, the initial social barriers must be identified and therefore be professionally dealt with as soon into the process of implementing the system begins.

Two main approaches that may be used to build momentum are: (a) education and training, and (b) surround and conquer (Metzger, 1984). Surround and conquer is used in the situation of modular method of system implementation, whereby the blockages created by individuals or departments that are politically or change resistant, can be eradicated when the efficiency and productivity of the adopted modules of the system is demonstrated. With a successful module adopted and operational, the logic of dissent can no longer prevail over the resulting benefits obtained by other operating groups, Metzger claims.

There is a danger that the use of a new junior manager or employee in attempting to establish a system will not generate sufficient motivation or momentum to the project to carry it through, lacking the credibility (Wight, 1981). Buswick (1990) agrees with this, discussing the requirements of a project champion:

> "an ingredient essential if the campaign is to motivate and instill loyalty into those around him."

This point is especially true when related to recent work by Barki and Hardwick (1989) that found that highly involved individuals are more likely to be resistant to change attempts when weak persuasive arguments are used to convince them otherwise, but much more likely to change their attitudes when presented with strong persuasive arguments. Thus the need for a strong motivating force.

1.5.8. Use of Teams

In Roa's (1985) model for the implementation of a PMS, he has a specific organisation phase which he claims is the most crucial to the implementation projects success. This phase deals with the establishment of the project teams and the appointment of the project leader in such a manner that will ensure a smooth management of the project. The other criterion that the management considers at this phase is the establishment and implementation of controls that will be invoked on the implementation project. These controls include the regular reporting of the project team to senior management or the appointed steering committee; the setting of target goals and the target dates by which to meet them; the project costs and budgets; and the extent of authority the project team may have in implementing the system.

On the issue of team leaders and the impact on the productivity of the group Buswick (1990) advocates that if the prospective team leader is weak or lacking any area, this can best be solved by the organisation of a team which will be able to cover these missing traits. This allows the inclusion of senior management, who may not have been represented as the project champion, to be included on the team process and thus leading and contributing to the vital aspect of top management commitment to the implementation of the change into the operations of the company. The use of a team will also serve to distribute the workload and thus allow the predominant team leader to complete his regular

workload. In the formation of this team, the possible barriers that may prevent it's success (Kneppelt, 1981) are:

- personnel with the required qualities for the team not within the company,
- problems with the inter-relationship of the managers on the team,
- losing sight of the requirements of the end-users of the change is introduced.
- reassignment of key project team members.

Buswick (1990) attributes the solutions to these problems to the responsibility of the champion.

1.5.9. Acceptability and Credibility

Understanding why users accept or reject computers has proven to be one of the most challenging issues in information systems and computer usage research. Davis, Bagozzi and Warshaw (1989) turned their attentions to the user acceptance of computer technology. They remark that as technical barriers continue to disappear, a pivotal factor in harnessing this expanding power becomes the ability to create applications that people are willing to use. The trick is to evaluate the system as early as possible in the system design for user useability and acceptability.

It has been shown that these attitudes of user acceptance are influenced in turn by various external factors. However it is important to recognise that the results of this research have been inconclusive and mixed. This may have been due to different attitude, belief, and satisfaction measures used by the various researchers. The external factors include:

1. The system's technical design characteristics.
2. User involvement in the system's development.
3. The type of systems development process used.
4. The nature of the implementation.
5. The cognitive style.

What various researchers developed was a model used to describe virtually any human behaviour, called the TRA - Theory of Reasoned Action. Davis, Bagozzi and Warshaw adopted and adapted this theory specifically to explain computer usage behaviour[2]. Their resulting model attempts to link two key beliefs:

1. perceived usefulness and perceived ease of use, and
2. user's attitudes, intentions and actual computer adoption behaviour.

The particular interest lies in the ability to predict and explain future user behaviour from simple measures taken after a very brief interaction with the system - a very useful model to use in reality in the primary stages of adopting a computerised PMS. Their work (Davis et al.) however was based on only one level: that of the management and supervisory staff - what is also of interest here is that of convincing the operator on the production floor to interface with and adhere to the system output.

Styles of adoption of systems have been found to have a direct bearing on the acceptability of systems. One in particular is the "cold turkey" approach which has been found to fail due to the desperation of the system operators when a problem is arrived at invoking a quick return to the old method of dealing with the problem; the net result being the operators using a different system to the one the management perceives as being in place (Rao, 1985). The use of the parallel approach of system introduction resulted in confusion and the resulting lack of acceptance manifesting a subversive disruption of the traceability of system problems. The most successful approach was found to be the pilot approach, whereby the introduction could progress in a controlled state, in contained environment and allow for comparison against the still existing "old" method.

[2] Their research was based on a longtitudinal study of 100+ MBA students and their voluntary usage of a word processor.

1.5.10. Resistance

"..resistance to change is by itself neither good nor bad. Resistance may be soundly based or not. It is always, however, an important signal calling for further inquiry by management."

- Paul R. Lawrence (1969)

On the subject of the inherent resistance to change and gaining acceptance of the system, there is the an element of change that must be contended with. Change is often perceived as a threat, an obstacle and source of future frustration. When considering the introduction of change into a manufacturing situation, Caruth (1974) maintains that there are five fundamental reasons why employees will oppose the change of the old system to the new:

1. **Economic security:** This is the first, most obvious reason, in that the employee may feel that the introduction of a new system, such as a PMS, may actually threaten his/her livelihood, and so may perceive it as a direct threat to job survival.
2. **Depersonalisation:** The change may carry with it the notion of powerlessness, loss of autonomy, or the loss of identity with the products of one's efforts. The "just being a cog in the machine", or the "just a company statistic" may creep in, and consequently it will be resisted.
3. **Changes to job status and hierarchy:** This is closely allied to the depersonalisation factor. Frequently changes do alter the established hierarchy of jobs, and their perceived status.
4. **New situation with new demands:** Generally the end product of the change is laden with uncertainty. There will be doubts in the employees mind as to his/her capability to cope with the new job demands, the old system was not a problem- how do I know the new system won't be? This can create a major problem in initially getting the system to be worked at.

5. **Increased complexity:** coupled with a new learning curve. It is unfortunate that many systems changes, far from simplifying things, have resulted initially in making the operations more complex and difficult. This may be viewed by some as a permanent state and may refuse to work with the change.

Lawrence (1969) referring to his earlier work dealing with the resistance to change within manufacturing organisations, dealt with the issue of participation of the operators in a change process, and emphasised the importance of the social effects of the change on the implementational success of the change.

1.5.11. Education and Training:

To ensure the efficient operation of any system the user must have adequate knowledge of that system. This is of primary importance to the success of the projected implementation. Thompson (1985), when documenting his company's successful MRP adoption and utilisation, stressed that all personnel were thoroughly educated in the operation of the system; just as Cox and Clark (1984) stated that a formal program of employee education is essential to the operation of a MRP II system. Dennis (1990) mentions that:

> "Training is a cost that small business owners admit they often do not properly anticipate. However, training is rarely a deciding factor in selecting a vendor to provide computer technology."

He states that while few small business owners in the US encounter employee resistance to new technology, the single biggest problem with new technology is employee training and education- an area where SMEs have been comparatively weak.

Millard (19) when discussing the area of MRP education, classifies several different types of training that may be necessary for system operators: generic education, software orientation, and applications training. He remarks that training can be very expensive and that too often the benefits have failed to justify the capital involved and the employee time given to the education effort. This does not mean to suggest that education should be lessened, only that it should be managed more effectively. Both Rao (1985) and Metzger (1984) agree on the need for supporting system documentation which should be updated regularly and adhered to as system policy. For this to work successfully, the documentation needs to be unambiguous, quickly accessible, and clearly written. Rao suggests the appointment of the system trainer with the responsibility of the constant updating and referral of the system documentation. This allows for any unanswered questions and new system technical developments.

1.5.12. User Involvement

Not only is user education of utmost importance, but so too is user involvement and participation in the selection, evaluation and implementation of the system. It is after all the users who will have to interface with the system the most often, and so the user's input must be considered from the initial system proposal right through to a fully operational live system and beyond - "user involvement is a full time effort" (- Maranka, 1972). Barki and Hardwick (1989), re-classified the definition of user involvement as a subjective psychological state in which the users are involved when they consider a system to be both important and personally relevant. User involvement, Maranka maintains, is a seven-step process, with users having inputs into the feasibility study, system design, documentation, and education, program testing, conversion, and final evaluation.

If the user is not involved in these steps, especially education of operating personnel, the likelihood of confusion reigning in the early days of operation will be high. What user involvement also serves to do is to help defuse what Caruth (1974) refers to as an "insidious form of aggression". This is the phenomena where workers spread rumours about the new system in order to discredit it; e.g. it will result in cutbacks of personnel, it will require a speed-up of effort, etc.. Lack of user involvement will not only serve to alienate the operating staff/users, but will severely reduce the chance of "getting it right second time round" -nobody can claim to have a totally satisfactory system first time out. To quote Brunsson (1982) "consensus rather than conflict breeds change".

1.5.13. Technical Problems

Blackstone and Cox, (1985) when discussing the implementation of MRP for SMEs, identify that control systems in a manufacturing environment are difficult to implement for several reasons. The first being the fact that the systems tend to be dynamic and a single change to end aspect of the system can manifest itself by generating several related changes. The second problem is that very accurate data is required for bills of materials, routings and inventory records; if this data is not highly accurate, there is a danger that the computerised system will order unnecessary parts and fail to order parts not in stock. Thirdly, a detailed and thorough knowledge of the operations of the manufacturing facility and the computer system itself is needed in order to ensure the reliable operation of the system. Cox and Clark class five main areas that technical problems will arise during system implementation. These include: System Design, Master Scheduling and Capacity Planning, Data Base Structure, Management of Inventory Levels, and Rescheduling.

Metzger (1984) feels that the use of the modular approach to allow the system to succeed in a situation where the existing system is firmly entrenched will serve to bypass any technical problems encountered during the change over. Metzger advises an order of implementation of the various modules of the MRP II system that would be most beneficial in replacing existing manual and semi-automated systems with on-line support. In order of decreasing priority they are: the company's engineering data base, stores control, MRP, shop floor control or PAC, the master schedule.

1.6. THE RESULTING FRAMEWORK AFTER COMBINATION

When the input from the fields of the production and operations management, management of change, and psychology literatures are combined the result is a balanced, more encompassing view of the problems faced during the introduction of the new technology into the organisation Figure 1.6.1 represents this process of introduction - which is in fact a process of change. With the technical project initiated from some point within the organisation, the largest task remaining is the assimilation of this technology into the remaining areas of the operation. This assimilation radiates in an even manner, drawing on the lessons learned from managing the change, overcoming resistance, and building of momentum.

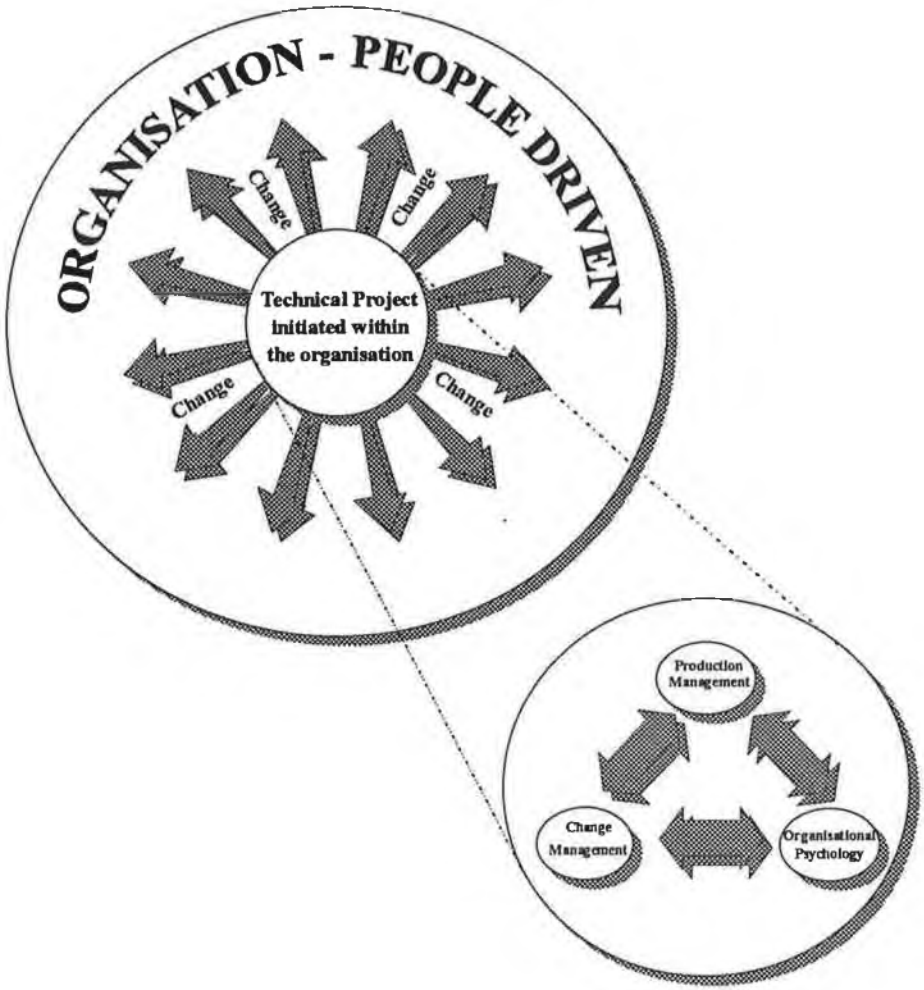


Figure 1.6.1 - The Evolution and Assimilation of a PMS into an Environment

As figure 1.6.1 illustrates, the environment into which the PMS is being introduced is becoming a predominantly people oriented one, with increasing emphasis being given to the role and importance of people in the success of the company. It is important that any introduction of technology into a company's operations takes account of this, and uses the inputs from the management of change and organisational psychology.

CHAPTER TWO

METHODOLOGY & RESEARCH DESIGN

2.1. INTRODUCTION

This chapter discusses two main areas: that of the actual routes taken in gathering the information required, and the justification of the use of these routes through an examination of their strengths and weaknesses. In doing this, the need for a formal, effective research methodology is presented and the various methods of collecting data necessary to satisfy the research objective. The method of selecting the sample frame and the resulting methods used to gather the information will be presented, along with the process of pretesting and piloting of the survey tools.

Flynn et al (1990) propose that all research is based on theory, and that the first step in conducting an empirical study is articulating it's theoretical foundation and determining whether the problem being investigated involves theory building, the practice of "building" a theory from data which was acquired with loose assumptions in mind[1], or theory verification, that of proving hypotheses generated in advance of the survey[2]. Following this a research strategy is selected and from this the most suitable data collection method. The final stage of implementation is the stage that involves the actual collection of the research data. This flow is represented in figure 2.1.1

[1] The theory must start with some theory or constructs, not an hypotheses, but rather some loose assumptions or frameworks.

[2] When using this avenue, researchers pay little attention to the origin of the theory, which my be from prior studies, literature, or "thin air". The focus of the study is on testing the hypotheses within the confidence levels.

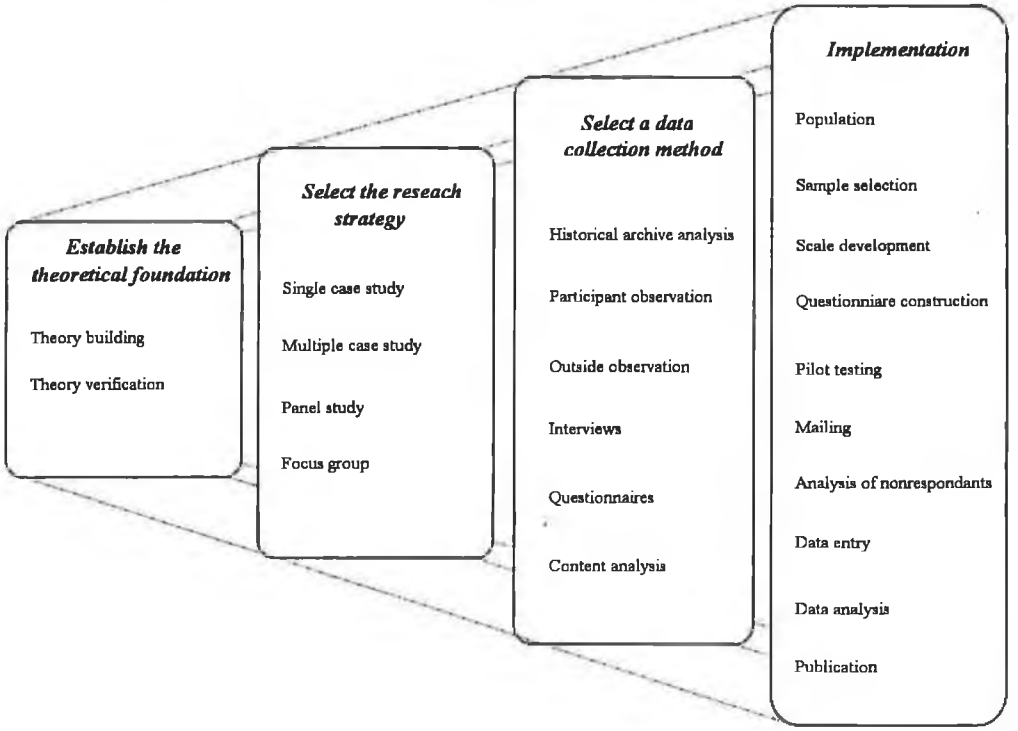


Figure 2.1.1 - A Systematic Approach for Empirical Research

When this is related to this research, the theoretical foundation is one of theory building, with an initial research strategy of multiple case studies. As will become apparent later in this chapter, it is at the data collection stage that two approaches are invoked. It was the widening of the conceptual framework that influenced the nature of the research design and the kind of data collection methods used.

2.2. RESEARCH OBJECTIVES

The main objective of the research project was to more clearly understand why the adoption and effective use of modern production management systems in Irish SMEs remains disappointing. The initial objective was to isolate and examine the key barriers or holding factors undermining their adoption and implementation. With these barriers and factors clearly identified, solutions and strategies may then be prescribed to combat the poor use of PMS in Irish

industry. In order that these barriers could be identified, a research design that would efficiently and effectively query the sample frame had to be developed.

2.3. THE RESEARCH DESIGN AND RESEARCH PROCESS

2.3.1. Research Gathering Methods

With the research objective in mind, it was important to chose a research technique that would allow for effective data collection of what the barriers are to PMS implementation in SMEs. In choosing the optimum research design - fundamentally the most important aspect of the entire research design process, careful consideration was given to the merits of research methods. While few methodological decisions that are taken could be labelled "wrong" (Fowler, 1984, p.141), each style of data collection has both strengths and weaknesses, and the purpose of the research design is to evaluate which style can be most efficiently tailored to gather the required information. Research gathering methods can be broadly divided into two categories, that of personal interaction with the informant and self administered questionnaires. For the purposes of this research it was decided to use case study semi-structured interviews, as the information required was of a qualitative nature and concerned only partially known phenomena that had to be explored.

2.4. THE INTERVIEW PROCESS

In order to address the research objective it was decided that the best method of gathering data would be to interview the case companies. The interview method was selected for two main reasons: (a) it ensured consistancy among the research sample in covering similar topics with each of the companies and (b) it allowed flexibility to pursue unexpected revelations or to discount sections

of the interview guide due to inapplicability. Other factors that made the use of the interview guide the most suitable research tool were:

(i) As the initial research was inductive and exploratory, breaking in to the area of a new and little known phenomena, the interview style suited in that it allowed non-verbal nuances and attitudes to be detected during the course of the interview.

(ii) It ensured 100% response rates, as all of the companies agreed to partake in the research process.

(iii) The ensured that every aspect of the questionnaire was answered thus allowing comparison between companies.

Figure 2.4.1 illustrates the path taken in the implementation of the interview guide process.

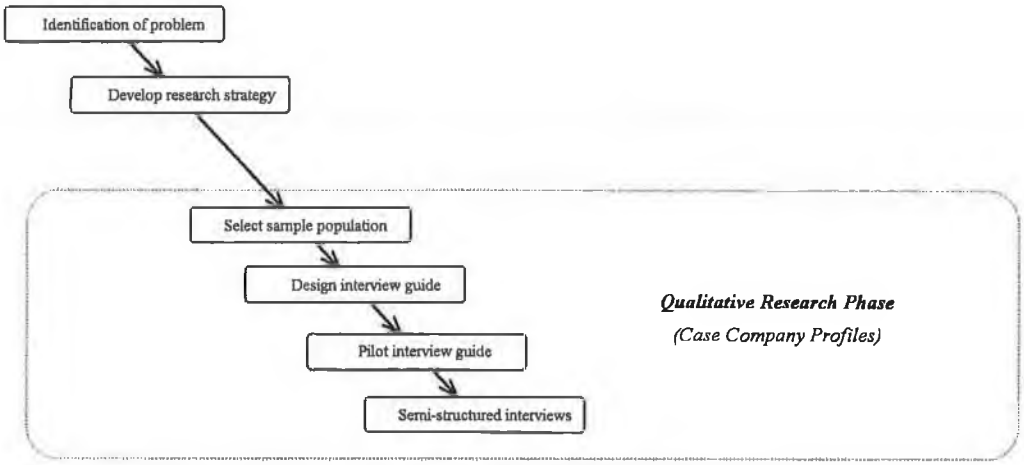


Figure 2.4.1 - The Interviewing Process

2.4.1. Personal Interview

The advantages associated with interviewing include a very high response rate with a greater chance of enlisting co-operation from the informants; also the

ability to collect the survey data in a number of different forms - including observations, visual cues, and hesitation (Fowler, 1984, p.70). The disadvantages that exist include the higher cost of transportation and possible accommodation and the employment of trained interviewing staff. There is also the high risk of information overload with valid information buried amid non-applicable information.

According to Moser and Kalton (1985, p.270), the purpose of an interview is neither to try to help the informant nor to educate him, but simply to seek information from the informant. It is a conversation between the interviewer and the interviewee for the purpose of gaining information on the topic in question. Work by Cannell and Kahn (1968) distinguished three broad concepts of the interview:

1. *Accessibility.* If the respondent does not have the information available or knowledge of it, the question cannot be answered.
2. *Cognition.* The respondent must understand what is required of his involvement in the interview. This includes establishing the relevant information to give and the style in which to answer the question. The interviewer is responsible for explaining this role.
3. *Motivation.* The respondent must be motivated to participate and co-operate in the interview. This includes not only the decision to take part, but also to provide accurate and complete answers to the questions.

When an interview is used as a research survey tool, the main aim is to attain uniformity in the asking of questions and recording of answers (Moser and Kalton, 1985, p.275). Thus the recording of the respondent's replies is crucial to the effectiveness of the interview. It is naive to expect perfect replies to all questions from all informants, in reality inadequate responses will be encountered quite often and must therefore be dealt with in a structured fashion. Kahn and Cannell (1957, p.217) classify five types of inadequate response:

partial response, non-response, irrelevant response, inaccurate response, and the verbalised response problem whereby the respondent explains why he cannot answer the question.

The use of personal interviewing can be divided in to two distinct areas: formal interviewing whereby the use of trained interviewers follows a rigid prescribed interview format, and informal interviewing[3], which allows more freedom for the interviewer to explore areas that may arise during the course of the interview. Formal interviewing has the merit of allowing the topic to be researched in a strict manner without deviation from the structured interview guide, yielding results that are strictly comparable and justified in combining into statistical aggregates. With this method there is no expansion or further explanation of questions, nor is there any interactive discussion. The method lends itself to mass surveys where numerous interviewers are required for use and thus consistency and uniformity is demanded. Examples of such surveys would include housing studies, social welfare surveys, and nation or area wide qualitative research.

The second method, that of unstructured interviewing, allows the interview to be customised for each informant depending on education, region, race, and social class. An interview of this fashion will generally encourage the informant to talk freely about the topic in question, with the course of the interview being guided by the informant. No set questions are asked and no interview framework exists. This method can be extended to allow for some control to be exerted by the interviewer and thus guide or focus the direction of the interview. What is allowed with this method is the ability to dig deeper into a subject and thus develop a clearer understanding of the topic. It also allows the

[3] Informal interviewing may also be refered to as unstructured, formative, flexible, qualitative, uncontrolled, or intensive. (Moser and Kalton, 1985, p.296)

unexpected answer to be fully investigated - a strength that the formal method would not allow. However, it must be noted that a fuller description may not be more accurate, and perhaps less valid than a shorter one. Studies by Hyman (1954) revealed that in certain cases shorter answers were found to have a higher validity than longer, confusing ones. The use of this creates interviewer bias and allows influence to enter the interviewing procedure, consequently reducing the validity and reliability of the results.

What was decided on was a combination of the two approaches - that of semi-structured interviewing. This allowed the benefits of the structured interview - that of the ability for comparison between the case companies, and the unstructured interview's benefit to dig deeper and chase areas of information that were peculiar to individual companies.

2.4.2. Design of the Interview Guide

As mentioned earlier, the use of the interview guide was necessary to ensure that common ground was covered with all of the participating companies so that the company "portraits" could be built up to allow for the comparison of the results. The interview guide is presented in appendix A.

The majority of the questions used in the interview guide designed for this research were open questions. This concurs with Moser and Kalton (1985), who advocate open questions because it gives the respondent the freedom to decide the aspect, form, detail and length of the answer (p.341). There is the problem however of coding or classifying the open, qualitative answers during the later stages of data interpretation (p.343), again with the problem of bias. But if the route of precoding or classification of question answers is followed to

make data interpretation easier, the danger that may arise is that answers may be forced into categories to which they do not belong (p.344).

With this format, areas ranging from company strategy to hardware costs could be investigated across the board. The typical interview lasting anywhere between 45 minutes to two hours, followed by a tour of the plant's operations.

2.4.2.1. The Order of the Questions

Moser and Kalton (1985) stress the importance of the order of questioning with particular importance given to the introductory questioning and style of interviewing (p.346). The reason for this is that at the beginning of the interview the respondent will be unsure of himself and should be thus put at ease to build up a rapport between himself and the interviewer. This may be achieved by ensuring that the questions are interesting, can be answered easily, and should not deal with sensitive topics that might prevent the respondent from further participation. Sensitive topics should only be asked at the end of the interview, in which case the respondent declining to answer and ending the interview, will result in relatively little information being lost (Sudman, 1982).

To ensure a logical and progressive order of the questions within the interview guide, it was divided in the following manner:

1. Company Facts
2. Education and Culture
3. Current Levels of Information Technology
4. Outline of the current Production Management System.
5. Implementation of the Production Management System.
6. Summary/Discussion Session.

The order of questioning should then proceed in a logical manner which indicates a progression from topic to topic, with link sentences. Where the link may seem obscure, an explanation clarifying the direction being taken should be given to ensure that the respondent feels that he retains total understanding of the interview process. A dictaphone was used to supplement the judicious taking of notes to ensure rich data retrieval, as advocated by Moser and Kalton (p.348), and Flynn et al (1990, p8)

2.4.3. Development of the Research Sample

In order that the research population may be represented fairly it is usual, in the case of a large population, to devise a sample that will be representative of it. In doing this the resulting sample must attempt to illustrate the trends and activities in a fair and even manner. It was decided that the research strategy would use multiple case studies (refer to figure 2.1.1, Flynn et al, 1990). The man reason for using multiple cases is that it allows for comparative analysis which can generate fresh insight into the process being investigated. It also helps to isolate more generic issues from firm-specific or sector-specific issues - an important when addressing such a wide objective.

As the research was concerned with the uptake of PMS by Irish SMEs, it was felt that the sample should provide an overview of the current state of PMS usage in Irish SMEs. The sample was broken into five CSO/OECD sectors, each sector representing a facet of the Irish manufacturing activities. The sectors chosen were: plastics, metal fabrication, toolmaking, printing, and food. As all of the manufacturing sectors could not be researched in depth, the decision to choose these five was based on the on the following criteria:

a) All of the sectors supplied foreign multinationals, thus were linked to multinational trends.

b) Access could be easily gained into these sectors due to existing contacts.

c) The companies participation in the National Linkage Programme; importance to the national economy and the presence of multinationals

All of these sectors included industries operating in a competitive environment, each with different styles of operations, different needs, but all with the common goal of profitability and increased control over their operation. These five sectors were further divided into three categories, giving a sample size of fifteen companies. Category one consisted of companies which operated no formal, modern PMS, while category two consisted of companies which had made an effort to implement a modern PMS, but for a number of reasons these systems had either floundered or failed thus preventing the full implementation of the system. Category three was representative of companies who had successfully adopted and were currently using a modern formal PMS. This sector division and categorisation is illustrated in figure 2.4.3.1

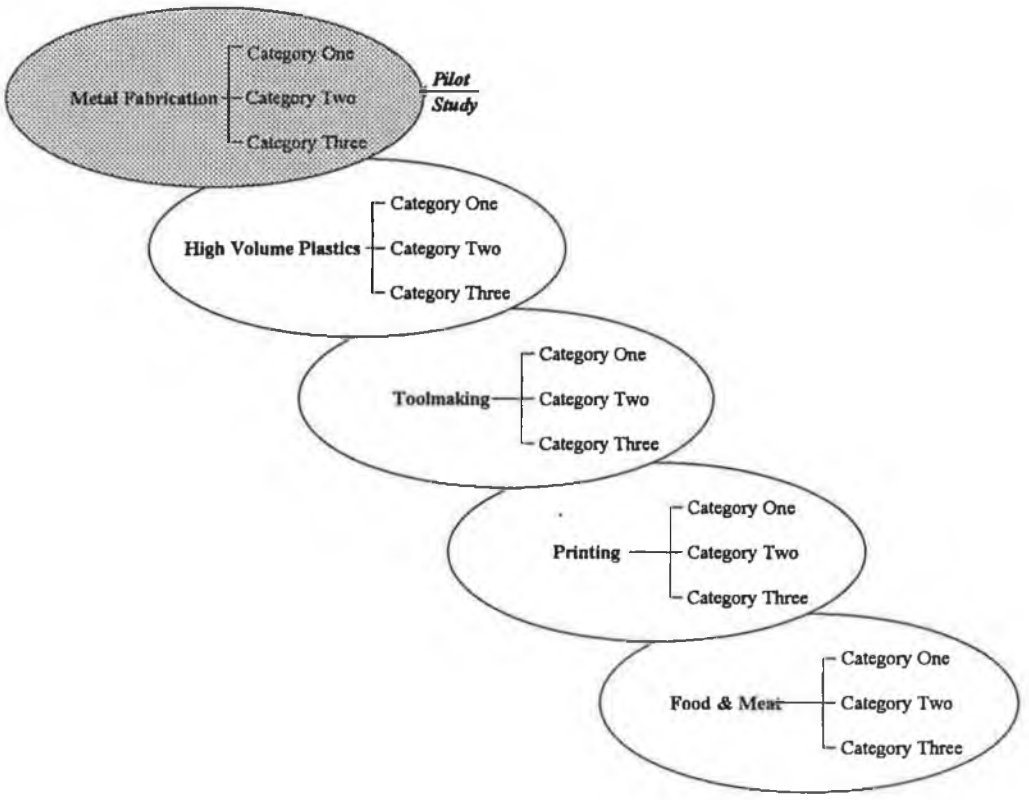


Figure 2.4.3.1 - Theoretical Company Stratification.

These three categories meant in effect that two distinct process were ebing researched: that of the adoption process, and the implementation process, with different case companies for each. A further dimension to this catagoroisation was that the transitions from category to category were being examined

2.4.4. Obtaining the Research Data / Information

After the interview guide had been discussed by using panel consensus and piloted, the entire sample of case companies were visited. The process of contacting and collecting the data from the case companies proceeded in the following manner:

(a) The case companies were contacted by AMT Ireland by mail inquiring if they would wish to partake in the research process.

(b) Following confirmation of participation, the company was contacted directly by telephone to arrange a suitable time with the interviewee.

(c) The interview took place on-site with the company, covering all aspects contained in the interview guide (appendix A) with in a time period ranging from forty five minutes to two hours. For the purposes of recording all the data, both annotation and dictaphone (used with permission only) were used.

(d) Case company profiles were constructed from the interview notes and dictaphone tapes, and the data was analysed.

2.4.5. Extending the Research Process

Upon completion of the interviewing process, it became clear that while the interviewing of the fifteen case companies revealed interesting and substantiated findings, it was desirable to broaden the research to allow for these findings to be tested for relevance by a larger sample. This next stage would also allow for the discovery of new factors that may not have been revealed by the interviewing process. However, it is important to note that the feedback from the fifteen case companies was always regarded as the main data, the further stage was essentially to test how general and reliable were the case company findings.

The extension and supplementing of a primary research method is a well practised and documented area. The use of combination research techniques has been advocated by various sources in published literature (Shaffir and Stebbins, 1991; Rossi et al, 1983; Gill and Johnson, 1991). The combination of differing research styles are used in cases of extending the research data, justification of the initial findings, or determining levels of confidence in developed theories. Shaffir and Stebbins (1991, p.6) developed a model that serves to explain the various levels in research of this division (figure 2.4.5.1).

In it they categorise all research into three categories: the research of little-known, partially-known, and better-known phenomena. Each of these three can be divided into the qualitative and the quantitative aspect of research, with distinction being made between inductive and deductive research.

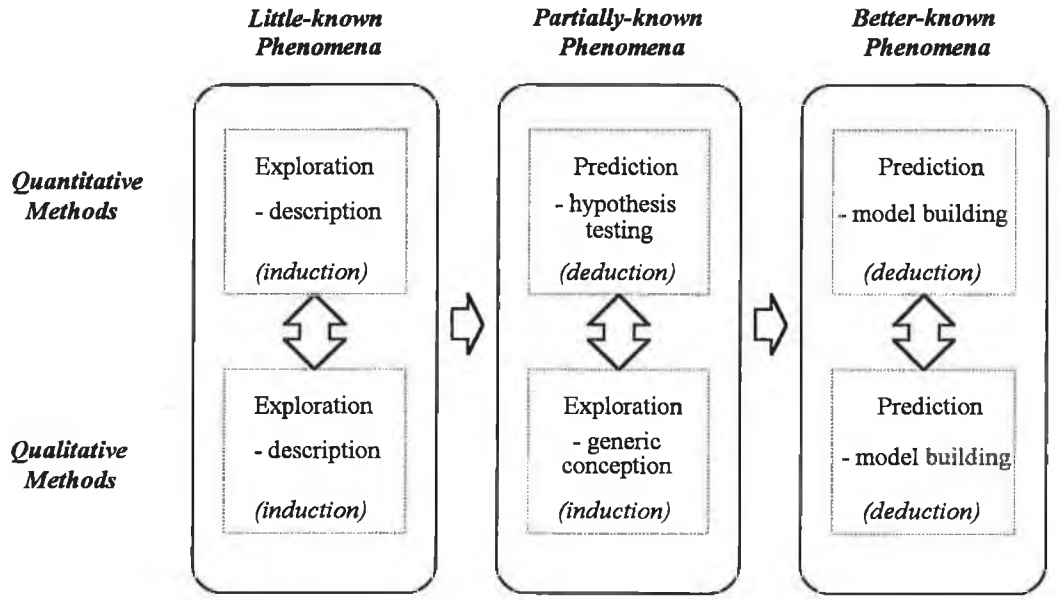


Figure 2.4.5.1 - The Relationship of Qualitative and Quantitative Methods.

Gill and Johnson (1991) provide definitions for both deductive and inductive research. Deductive research they claim follows that:

> "A deductive research method entails the development of a conceptual and theoretical structure prior to its testing through empirical observation" (p.28)

while in the case of inductive research:

> "the logical ordering of induction is the reverse of deduction as it involves moving from the "plane of observation of the empirical world tot he construction of explanation and theories about what is being observed."(p.33)

In the case of this research, categorisation is made less clear-cut, as the secondary process was to be both a validation and a discovering phase. So while the initial qualitative inductive phase was one of exploration, the following quantitative stage contained both exploratory and predictor attributes, combining inductive and deductive research logic.

Gill and Johnson (1991) describe in their work a research method that results in the choosing of either personal interviewing or self-administered questionnaires. As it was deiced to complete the research gathering process with the use of a self-administered questionnaire, their model may be modified (figure 2.4.5.2) to explain the resulting combination.

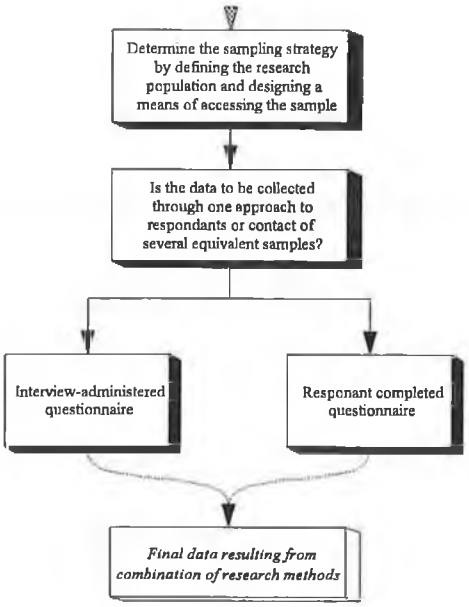


Figure 2.4.5.2 - Modification of Gill & Johnson's Survey Planning Model

Dillman, in his work in Rossi et al (1983), remarks that self-administered questionnaires can be used to supplement the information gained via the face-to-face interview. The combination of the two research styles resulted in more accurate, quality data than just one alone.

Various methods were available to extend the research in to this validation area, the use of mail survey, telephone surveys or the use of fax distributed surveys. What also had to be considered was the size of the second research sample. Figure 2.4.5.3 presents the various options that were open for use. After consideration of the various methods, it was decided to survey a large random sample by means of a fax based survey (figure 2.4.5.3).

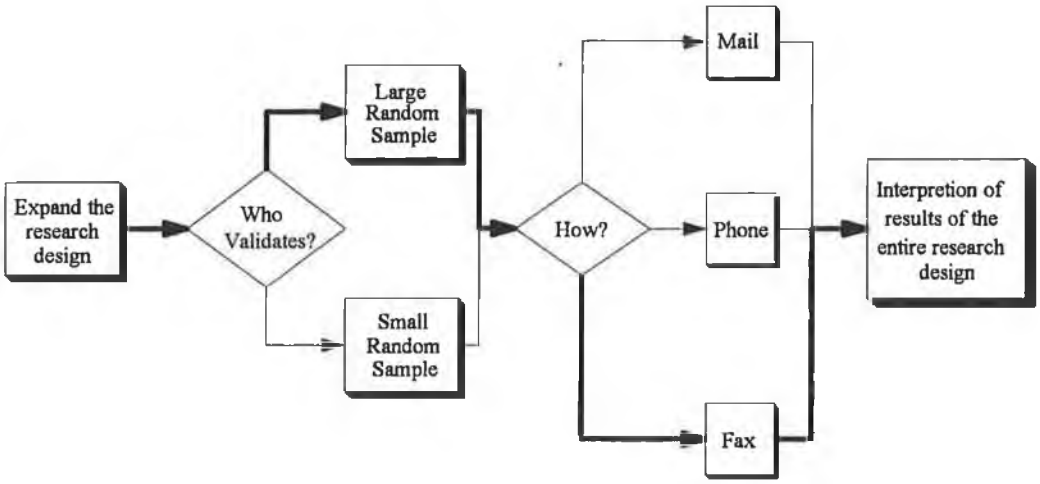


Figure 2.4.5.3 - Extending the Research Process

2.5. THE SURVEY QUESTIONNAIRE

Having decided on the use of a questionnaire distributed by fax, the what remained was to select the survey population and design the questionnaire. This process is illustrated in figure 2.5.1.

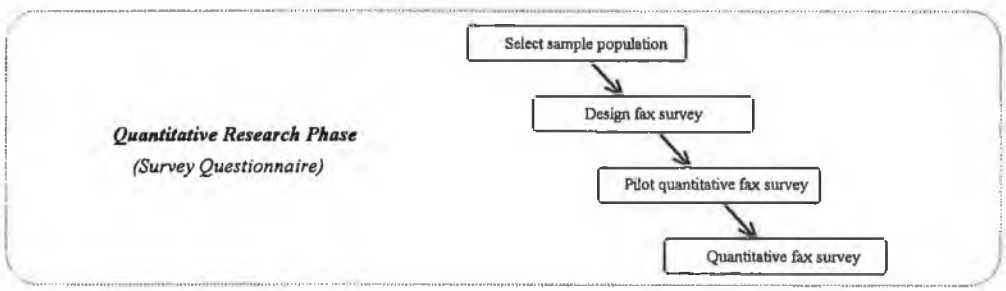


Figure 2.5.1 - The Survey Questionnaire Process

2.5.1. Company Selection for the Survey

For the purposes of the fax survey, the sample size was considerably larger than that of the multiple case company process. The sectors were extended to include timber and electronics together with the five sectors already chosen. The selection of the sample companies, taken from the EOLAS computer database, were based on the NACE system of industrial classification. There were two main criteria in company selection:

- All of the companies were manufacturers.
- There was a balance between sectors.

215 companies were selected from the NACE (the general industrial classification of economic activities with the European Community), the divisions and classifications of which are presented in table 2.5.1.1.

Division	Class	Description
3	31	Manufacture of metal articles (except for mechanical, electrical and instrument engineering and vehicles)
	34	Electrical engineering
	35	Manufacture of motor vehicles and of motor vehicle parts and accessories
4	41/42	Food, drink and tobacco industry
	46	Timber and wooden furniture industries
	47	Manufacture of paper and paper produces; printing and publishing
	48	Processing of rubber and plastics

Table 2.5.1.1 - Divisions and Classifications of the NACE Surveyed.

Of the 672 companies listed in these classifications, 215 were selected and 158 contacted by telephone and fax. This process is illustrated in figure 2.5.1.1.

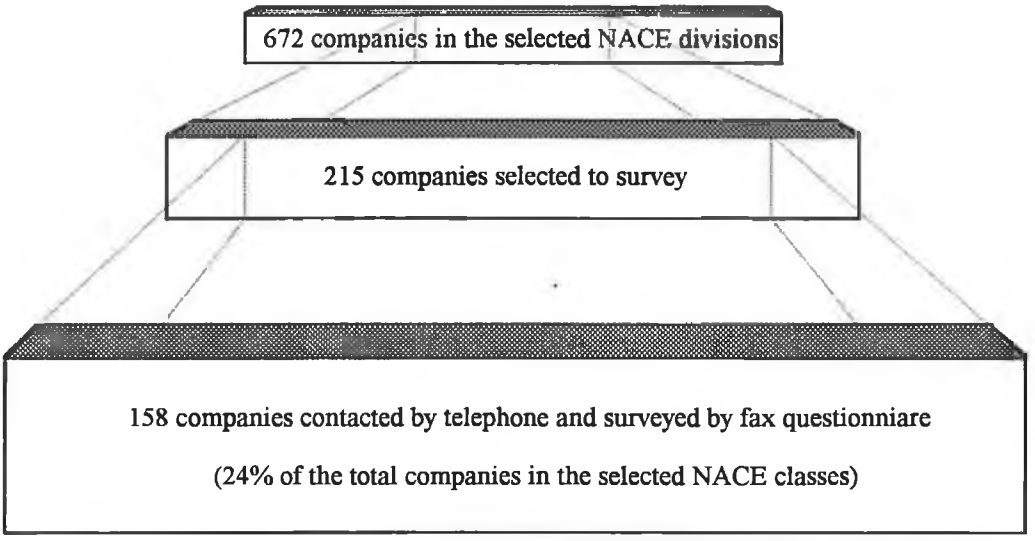


Figure 2.5.1.1 - Company Selection for Fax Survey.

2.5.2. Design of the Survey Questionnaire

"no survey can be better than its questionnaire"

- Moser And Kalton (1985, p.308)

As the self-administered questionnaire was being distributed by fax, there were some considerations to which attention had to be paid. These included the design being constricted by length, and the sacrificing of space and large spacious questions for a smaller, more concise style. The content of the questionnaire was based on the information received from the qualitative case company interview process, and included some further information required to supplement the existing data. Gill and Johnson (1991) comment that-

> "A vital skill in undertaking a survey is the ability to structure, focus, phrase and ask sets of questions in a manner that is intelligible to respondents." (p.84)

In the model they devised to cover the entire survey process, the first two stages, that of determining the questionnaire format and the fieldwork, are at issue here. They pay particular attention to the style of wording used and the method of response to be elicited from the respondent. Figure 2.5.2.1 represents the path that they outline in the construction and execution of a questionnaire process.

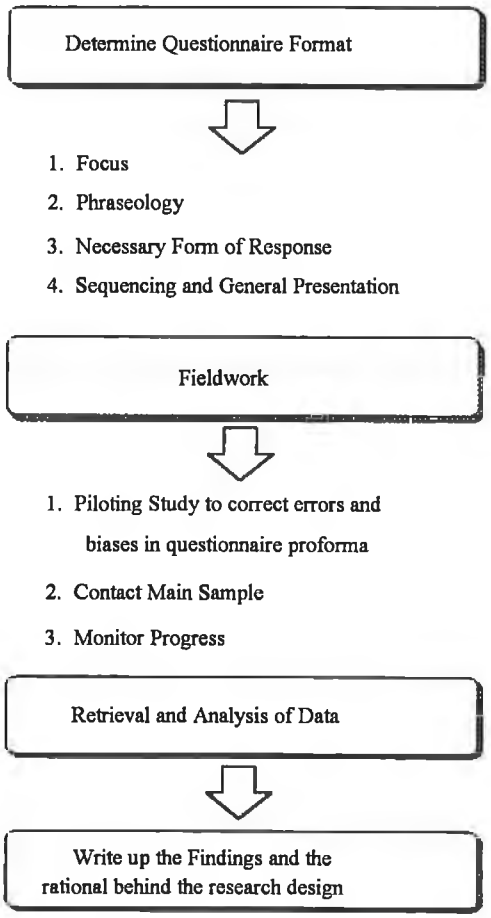


Figure 2.5.2.1 - Gill & Johnson's Questionnaire Format.

The questionnaire was designed ensure clarity, with the use of common words and relevant acronyms where needed, the style of response to the closed questions involved the ticking of set-answer boxes or the provision of room for other replies. In all cases, the ability to code the replies clearly and unambiguously was ensured. The style of questioning was predominantly closed questions (allowing computer coding) with the few open questions occurring at the start and dealing with such information as respondents name, company activity, main product line, and at various stages in the questionnaire reasons for supplying a particular positive answer to some of the questions, in order to clarify and enrich the data gathered. While open questions do allow respondents to "reply in their own frame of reference, entirely unhindered" (Rossi et al, 1983, p.206), closed questions were favoured over the use of open questions due to open questions:

> "invariably elicit a great deal of repetitious, irrelevant material. Respondents often miss the point of the question, pour out a great many words that bear on the issue only marginally, or..." waste time as they "...try to organise or articulate their thoughts" (p.207)

2.5.2.1. The Length of the Questionnaire:

The number of pages was limited to three as it was felt that any more would:

- make the questionnaire too long and result in the interviewee not completing it, and
- would cause annoyance to the recipient of the survey due to the use of the recipients fax machine and paper.

The resulting questionnaire that was developed had to be edited to ensure that it was not overlong. As Moser and Kalton remark there is a temptation always present to cover *too* much, to ask questions regarding everything that turns out to be interesting, but it must be resisted. The comment that-

> "Lengthy, rambling questionnaires are as demoralising for the interviewer as for the respondent, and the questionnaire should be no longer than is absolutely necessary for the purpose." (p.309)

According to Sudman and Bradman (1982) self administered questionnaires must be kept short unless the topic is highly salient and pertinent to the respondent. This mirrors their belief that questions should look only for short answers, thus reducing the time spent dealing with the questionnaire and consequently affecting the judged length of the survey tool. The reason for provoking short answers is that the respondent is likely to refuse to complete the questionnaire if requested repeatedly for lengthy responses.

2.5.3. The Survey Process:

Following the pretesting and piloting of the survey questionnaire, it was then distributed to the research sample. The questionnaire was distributed by fax in the following sequence of events:

(a) The company was contacted primarily by telephone and asked if they would be agreeable to take part in the survey. The purpose of this was two-fold: the first was to get permission to fax the survey, the second was to request the name of a suitable respondee within the company to whom the questionnaire would be addressed.

(b) The survey was faxed to the company within eight hours of the initial telephone call. The time delay was due to the questionnaire being faxed at night while the majority of the fax lines to the survey companies would be free.

(c) Those that did not respond to the initial fax within ten working days were contacted by telephone and asked if they would like another copy forwarded

(d) The second copy, if requested, was faxed to the company.

When the completed questionnaires were returned either by fax or by mail, the responses were coded and entered into an SPSSx© data file for data interpretation. The use of the survey questionnaire served to continue meeting the research objective, expanding on what was discovered during the initial interviewing phase, yet still serving to discover data that might have been missing from the qualitative research sample. The use the fax as a communications survey medium rather than mail proved itself to be:

(a) quick and easily delivered efficiently to the company

(b) easier to provide control in distributing the questionnaire as it's delivery was acknowledged as a certainty to the company in question.

(c) a method that involved obtaining the contact name necessary for an accurate response, due to the initial telephone call prior to the faxing of the questionnaire.

2.5.4. Self Administered Questionnaires

The merits and disadvantages of the use of a facsimile as medium for the distribution of survey questionnaires can be likened to those of a mail survey. The advantages of the use of mail surveys is highlighted by Moser and Kalton (1985, p.257) and Rossi et al (1983) and includes such merits as its cost, which either fax or mail, is inexpensive when compared with the cost of carrying out a similar wide reaching survey by interview means. As Selltiz (1959) remarks:

"Questionnaires can be sent through the post, interviewers cannot."

It also avoids the problems associated with the use of interviewers, and resultant interviewer error and bias, which may serve to undermine the validity of the survey. it also offers the facility for the answer to various questions to be investigated and the correct information sourced, something that interviewing does not allow as immediate answers are usually required. What the mail/fax

survey also serves to provide is more accurate information on topics that might prove to be embarrassing or threatening to the person completing the questionnaire. Sheatsley (1983, p.198) reinforces this point: "mail surveys may produce more valid responses to certain types of questions where the presence of an interviewer might be inhibiting". The chance that the person required to complete the questionnaire not being available when an interviewer would all is circumvented with mail and fax surveys thus lowering the rate of non-contact. Perhaps the most striking benefit of the use of a fax based survey is the speed by which the interviewee can be contacted after the introductory telephone call.

Fowler (1984), discusses the lack of quality control of the responses given on a self-administered questionnaire. He cites that without an interviewer present there is a risk that the questions may not be (a) fully answered, (b) the responses may not meet the question objectives and (c) that the quality of the answers may not be sufficient for data analysis. He identifies a key disadvantage in the use of self-administered surveys (p.103) in that:

> "For self administered questionnaires...the formatting is more important (than administered interviews). In contrast to interviewers, respondents do not receive the benefits of training, they usually are not motivated to do the job well, and they are not selected on the basis of their ability to handle questionnaires."

Fowler also mentions the ineffectiveness of a mail survey in enlisting the co-operation of the respondents, although he does recognise that this is dependant on the group being studied. Moser and Kalton (1985, p.260) describe six key disadvantages to the mail questionnaire method:

1. Only sufficiently simple and straightforward questions can be used that can be answered by a wide range of differing levels of education. It is unsuitable where the objective and purpose of the survey takes a good deal of explaining.
2. The information given has to be accepted as final, with no opportunity to probe beyond the answer or clarify ambiguous questions. The remark that the mail questionnaire "is an inflexible method"
3. It is unsuitable if spontaneous answers are needed.
4. During the process of filling out the questionnaire, the respondent can see all of the questions before answering them, thus independent answering of questions can be biased.
5. The right person may not always complete the questionnaire resulting in poor or inadequate information from a less enlightened source.
6. Due to the self-administered nature of the mail questionnaire, there is no opportunity to supplement the respondent's answers with observational data.

Dillman (1983) reiterates these disadvantages put forward by Moser and Kalton (1985), and adds that the low response rates generally infer a resultant bias in the question answers and also question order bias may also occur because the respondent will have had the chance to study the whole questionnaire before answering.

2.5.5. The Complete Research Process:

When the two research steps are combined the resulting entire process can be summerised in figure 2.5.5.1.

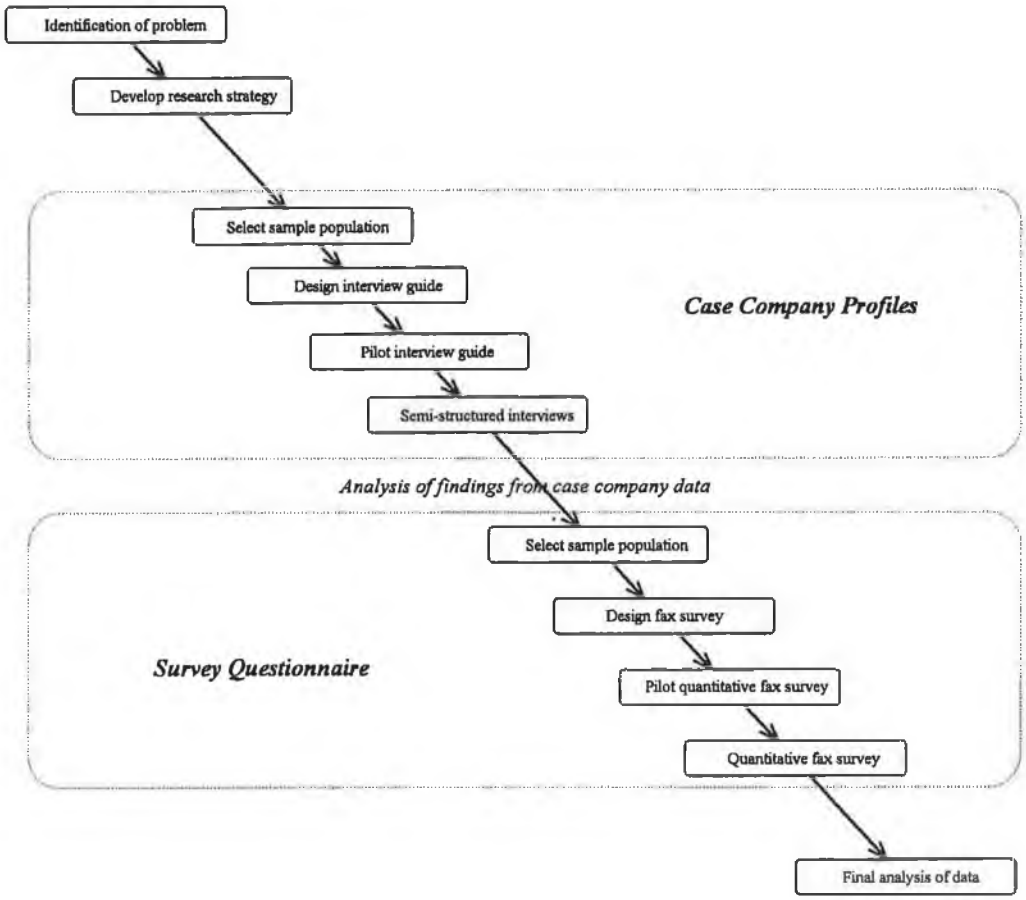


Figure 2.5.5.1 - The Total Research Path

2.6. PRETESTING AND PILOTING

In order that the research process was a valid exercise, probing areas that were of use in addressing the research objective and asked in such a manner that they were easily understood by the interviewee it was imperative that each of the research methods were tested before the full process began. In the case of the interview guide, initial drafts were tested in the field to ensure that the major themes were being addressed in a suitable manner. Also with the survey questionnaire, several versions were tested on sample companies to ensure ease of understanding and usable feedback. Essentially, it was important to evaluate that the research design was yielding the kind of data needed to satisfy the research objective

2.6.1. The Purpose of the Piloting Process

The use of pilot testing of any research tool is well documented, with reference both to interviewer administered surveys and self administered questionnaires. The piloting of the research tool is the stage at which the research gathering tool is tested in the field to refine the tool's design and identify errors and inadequacies. It is the stage that determines the potential effectiveness of the research tool, and is always conducted prior to the final gathering of the data. Green, Tull and Albaum (1988, p.185) remark that is "the activity related to the development of the questionnaire or measurement instrument to be used in a survey or experiment", - a dry run of the final process. Backstrum and Hursch (1963) cites pretesting as an instrument that is necessary because no amount of intellectual exercise can substitute for actually testing an the final instrument. Fowler (1984), mentions in his book, p. 103, that:

> "Whether the survey is to be interview-administered or self administered, the goal of the layout and format of the questionnaire should be to make the tasks of the interviewer and the respondent as easy as possible."

Piloting or pretesting of a survey can serve to provide information on how long it takes to conduct the interview or complete a self administered questionnaire, and it can be to indicate questions that need to be revised or eliminated due to either lack or clarity of creation of confusion, Sudman (1986). Reynolds et al (1993) split the pretesting of the research tool into two distinct areas: (a) pretesting the individual questions, and (b) checking the overall design.

There are many styles of questioning that can cause concern and result in poor collection of data. These include double questions, ambiguous questions and word meaning, loaded or leading questions, lob sided or missing response categories, and the level of question difficulty. The flow of the questions, or the

order in which the questions are asked can also be tested in the piloting procedure. What can also affect the questionnaire and it effectiveness is the layout, colour of the paper, or the typeface and size of the script (Sudman, 1986).

Both phases of the research process were piloted to ensure that the tool being used for the process of gathering the data was valid and non confusing.
Fowler (1984) remarks that:

> "Once a set of questions is close to ready for pretesting, they need to be put in a form to facilitate interviewer or self-administration."

By this he is referring to the layout and order of the questionnaire or interview guide

2.6.2. Piloting of Interview Guide

The interview guide was pretested with one of the manufacturing sectors, metal fabrication, to ensure that it met all of the criteria for the effective use of the guide and that it captured all of the elements necessary for effective data collection from the entire sample. The reason that the guide was piloted on a sector of the final sample was that, as Reynolds et al (1993) state, when the target population is very small it is impossible to pretest a questionnaire in subjects who could then be missed out in the experiment. Figure 2.6.2.1 illustrates this piloting procedure. It was found from this process that although no major changes were necessary, the use of visual aids was of no major addition to the information yielding process, and if anything perhaps served to confuse the informant.

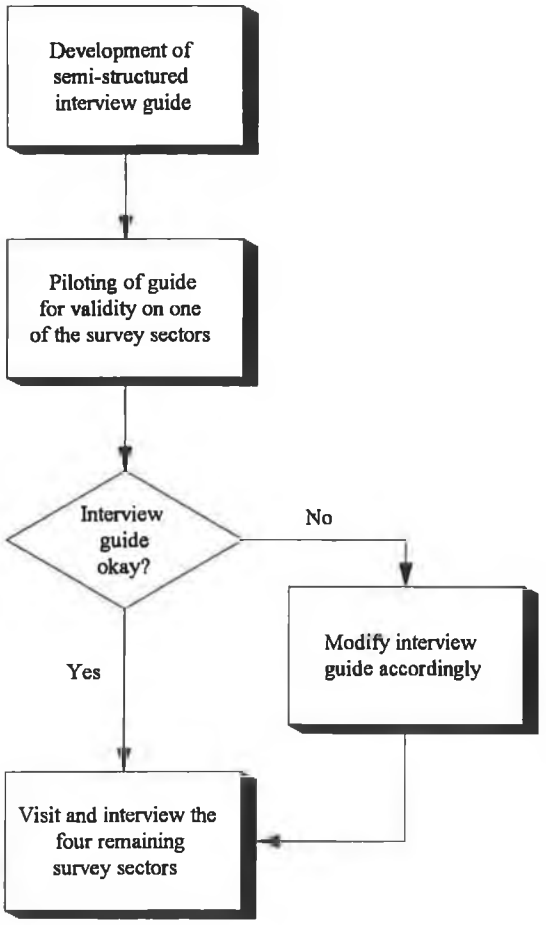


Figure 2.6.2.1 - The Piloting of the Interview Guide.

2.6.3. Piloting the Survey Questionnaire:

Following the development of the survey questionnaire, it was piloted using five randomly selected companies from five different manufacturing sectors. The companies were contacted in the similar fashion that was to be used for the final survey - by telephone. Following this the questionnaire was faxed to the company and the respondents were asked to note the time taken for completion of the questionnaire. Room was left on the questionnaire for the inclusion of commentary and criticism by the respondees, and this was followed up by telephone. Several changes were made to the questionnaire based upon these

recommendations and the edited questionnaire was repiloted to a new sample for further pretesting and criticism, as recommended by Sudman (1984, p.285). When the questionnaires were received the changes were considered and the final questionnaire was completed (figure 2.6.3.1).

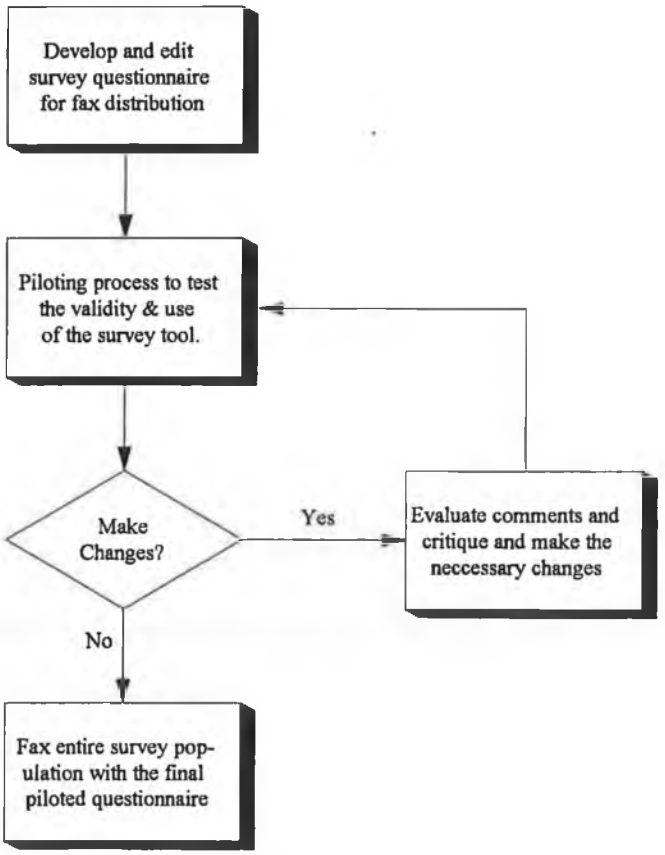


Figure 2.6.3.1 - The Piloting Process of the Survey Questionnaire

2.7. RESPONSE RATES

The questionnaire survey yielded a response rate of 20%, with 30 companies responding from the 156 contacted. There are several reasons that can explain

this low response rate, with either one or a combination being the dominant factor. They are:

1. The contact name was unavailable when the survey was received.
2. Lack of information on all the aspects asked could have dissuaded the questionnaire's completion.
3. The length of the questionnaire could have prevented it's completion.
4. It could have been perceived as being non-applicable to some of the receiving companies.
5. The person contacted may not have been present when the system was introduced and thus felt unable to fully answer the survey.
6. The respondent may not have felt sufficiently motivated to complete the task.
7. Some respondents may have found the questionnaire design confusing.
8. It may not have been passed on to the correct person for completion.
9. The questionnaire could have been lost.
10. The questionnaire could have been completed but not returned.

Any survey needs an adequate response rate to lend credibility to their findings. The levels of response rates vary depending upon style of research gathering method used, nature and characteristics of the research sample, field of research and area of interest. When a survey was carried out in the UK on small businesses and their banking habits, the mail survey elicited a response rate of 19%, which the authors remarked was relatively high (Cowling, Samuels and Sugden, 1991).

2.7.1. Factors Inhibiting Response

Fowler (1984, p.66) remarks that "the problem of non response is central to the use of mail surveys" and also notes that "obtaining an adequate rate of response

is a special challenge of mail procedures". Moser and Kalton (1985, p263) cite the inclusion "of a single awkward question might result in a high rate of non-response."

Fowler cites three reasons to explain why data is not returned:

1. The data collection procedures did not reach or get to the respondents, thereby not giving them a chance to answer questions.
2. Those asked to provide data refused to did so.
3. Those in the sample asked to fill out the questionnaires could not perform the task.

Flynn et al (1992, p.6) add to Fowler's first point when they remark that "because production managers spend so much of their time on the shop floor, they can be virtually impossibly to reach by telephone"

2.7.2. Measures Improving Response

Moser and Kalton (1985, p. 266) discuss the use of follow-up as an effective method of raising the response rates. Either with the use of a short reminder letter or a remailing of the questionnaire. The use of this follow-up procedure increased the response rate by approximately 20% in some reported cases. The drawback to this they remark (p.266) is that the second contact may serve to undermine the respondees feeling of anonymity and thus may be less likely to respond, although Fowler (1984, p.55) advocates a confirmation of anonymity in the reminder letter to circumvent this; also the quality of the information received from the second mailing may decline from the first. round of distribution.

Following the distribution of the questionnaire, a time period of approximately one week was allowed after which the companies were re-contacted and

questioned as to whether or not they had completed the questionnaire and if they would like a second copy faxed.

CHAPTER THREE

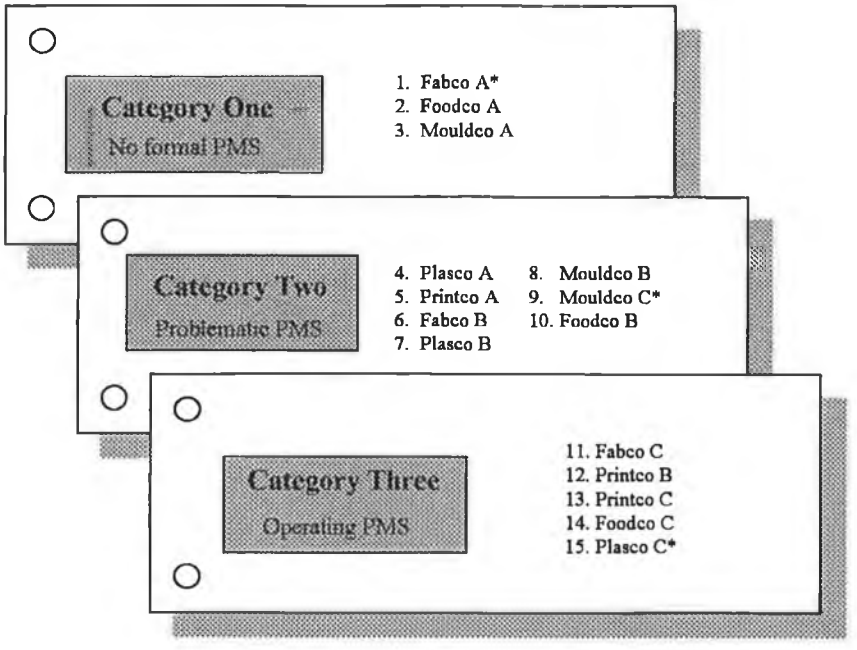
CASE COMPANY PROFILES

3.1. INTRODUCTION

As was outlined in the previous chapter, the companies that were selected as case companies represented five sectors: metal fabrication, high volume plastics injection moulding, food, toolmaking, and printing. These five sectors are represented by three categorisations classing the level of production management systems in operation. Representative companies from each of the categories are portrayed here, profiles of the remaining nine companies are presented in appendix C. The profiles are presented under specific headings which correspond to the structure of the interview guide used in the data collection process. This approach allows for comparison and contrast of the companies across sectors and categories.

3.2. CASE COMPANIES CATEGORICAL REPRESENTATION

While the original company stratification was designed to have all three categories represented in the five sectors, in reality when the companies were examined it was found that some of the categories were not represented. Figure 3.2.1 illustrates the actual representation of sectors by the different categories.



** Companies profiled in this chapter*

Figure 3.2.1 - Categorical Representation of Case Companies.

As can be seen from figure 3.2.1, company names have been omitted and pseudonyms used. The convention used in one whereby the sector is abbreviated in to the title of the company; i.e. Fabco A is a company in the metal Fabrication sector, Plasco C a company in the plastics moulding sector. A, B and C are simply used to identify the different companies in each sector.

3.3. CATEGORY 1 (NO FORMAL PMS) COMPANY EXAMPLE: FABCO A

3.3.1. Company Facts

Fabco A is a small company engaged in the fabrication of sheet metal into pressed steel products. One of the main products that the company manufactures are industrial steel anchored tiles, the previous range of fire-screens and spark guards being discontinued in favour of the new products. 95% of Fabco A's production is Make To Order (MTO), with the remainder being Make To Stock (MTS). They have also got the facilities for some custom engineering work. Table 3.3.1 summarises some of the company facts.

Category	Estb.	Employment	Turnover	Environment	Quality
One	1985	13	£500K	MTO & MTS	No standard

Table 3.3.1 - Summary of Company Facts

Only two products are held in stock as raw materials, and there is a high rate of inventory turn on these, due to 2,000 floor tiles being manufactured every week. The maximum supplier lead-time is six weeks, although with expediting of the purchase orders, this can be lowered to three weeks. The company sells directly to the product's consumers, with no wholesalers supplied.

3.3.2. Organisational Structure, Planning and Quality

Fabco A has no formal quality standard, and is presently not seeking to pursue the ISO 9000 quality standard. Due to the small management team, presented in figure 3.3.2, and the fact that it is an owner-founder-manager situation, there is a very dictatorial, autocratic management structure, with little bureaucracy. Operation input is, however, considered in production alteration or operation changing decisions.

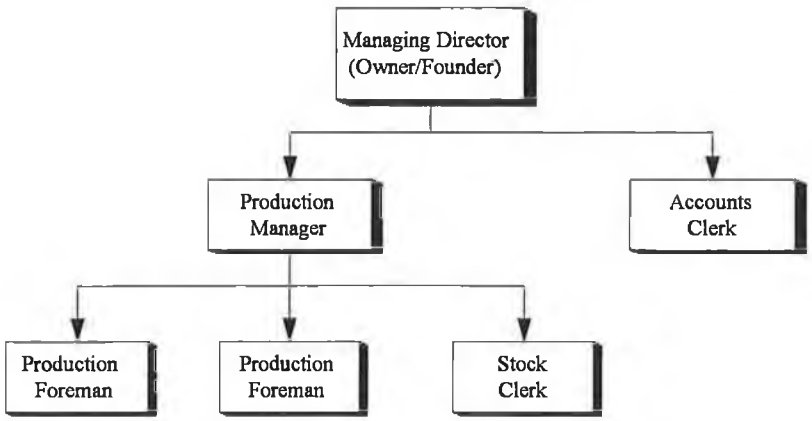


Figure 3.3.2 - Organisational Structure of Fabco A.

The company does have a semi-formal business plan, but it was felt that the short term goals did not reflect the long term goals, and indeed in some cases, were seen to totally oppose them. The company has expanded in the last two years, doubling it's labour force and adding an extra department (a new machine shop and a shot blasting mill).

3.3.3. Education

The production manager attended a course through his TechStart contract on quality management. The company has never attended any seminars or workshops, but would consider facilitating time-off and financial aid to attend relevant courses. At operator level the average standard of education would be intermediate certificate, with one employee holding a City and Guilds certificate. The company does not permit time or

financial assistance for education of operators, as it would prove too costly. One of the supervisors completed an IMI course relevant to his position.

3.3.4. Current Levels of Information Technology

Fabco A currently uses one personal computer, operating a word processor and an accountancy package. The combined total invested in this is approximately £3,000, and is under the sole usage and control of the accounts clerk. The computer was acquired three years ago on the recommendation of the company's external accountant as a fundamental need for the company. The production manager, when consulting the accounts clerk, uses the information from the system, but the managing director has never had any interest in the computer or it's usage. An upgrade is envisaged in the future.

3.3.5. Current Production Management System

Fabco A currently manages it's production in an entirely manual style unchanged since the company's foundation. The production manager is not happy with the system, commenting that "it could be improved greatly". There are no linkages between sales, production, marketing, and scheduling, and the system is, in the words of the production manager, "holding back production". As it is so informal it can be flexible to whatever new processes or changes are made within the company. Only the accounts clerk, the production manager, and the three production supervisors interact with the system, and where the problem begins is that each may perform an activity and not record it immediately - thus the activity may be repeated by another unknowingly. This has led to multiple ordering, stockouts, and de-expediting of production orders on the floor. The production manager has tried to introduce a skeleton manual in which to enter all orders and changes, but he is finding this difficult to maintain, -"it is just a short term solution, - not at all ideal." He has found this system to fall foul to integrity, memory, and reliability of the supervisors. What

complicates this further is that there are no job numbers or order numbers, so tracability is made very difficult, and for job costing estimates old diaries have be checked for historical figures. Capacity planning is also made difficult due to only the bare information from each individual customer order entry available to act upon.

3.4. CATEGORY 2 (PROBLEMATIC PMS)COMPANY EXAMPLE: MOULDCO C

3.4.1. Company Facts

In 1991 Mouldco C, a Japanese company, fully acquired the operations of an Irish moulding company with which it had been in partnership. This was the turning point in the success of the company which had been experiencing financial problems up to this point, and with the increased capital injection, it enabled the company to attack the market on a more secure footing. Table 3.4.1 presents basic company facts.

Category	Estb.	Employment	Turnover	Environment	Quality
Two	1986	44	£1.4 M	ETO	ISO 9001

Table 3.4.1 - Summary of Company Facts

The company has two distinct internal divisions - the moulding department, and the tool making department. The moulding department produces moulded components for the electronics industry - television cabinets, kitting boards, computer cabinets, and other moulded components for electric consumer goods. The tooling department is then responsible for the design and manufacture of the moulding tools required by the moulding department. The tooling department also manufactures and services others companies requirements. It is the activities of the tooling department that is dealt with in this profile. The company holds approx. 3,500 components in stock, and

a mid-size tool consisting of approx. 1,000 components. The average manufacturing lead time is 8 to 14 weeks, the longest supplier lead time being six weeks. The company has recently invested £750K in new machinery and a CAD system. The time scheduled for recouping the this outlay, which was in the form of a loan form the Japanese parent, is 24 months.

3.4.2. Organisational Structure, Planning and Quality

The organisation structure of the company is a reasonably flat with the company having strong middle management, with an outward looking philosophy which it tries to maintain while constrained within the company structure. There is no special systems manager in the company, the production manager assuming this responsibility. While a lot of paperwork and use of forms is very prevalent, there is freedom for employees to expedite jobs and take initiative in decision making to ensure the smooth running of the company's operations. Communication barriers do not exist due to the hierarchical system, and due to the ISO 9001 clearly defined procedures do exist, as does clearly defined delegation of authority and responsibility.

The company's strategy is quite clear in where it would like to position itself in the market place. It sees itself as a producer of quality moulding tools, and wishes to expand further into the electronic components market. This is reflected in the company's five year business plan, with particular attention given over to the growth of the firm and it's expansion of it's customer base. They have also been in contact with UCD on the issue of design and manufacture, and also with Forbairt. Also the membership of the Mould makers Association allows the tool making companies in Ireland to consolidate and "dole out" the market share areas, both on the domestic and export markets. They also serve to market the Irish tool making industry abroad. The short term force driving this need for expansion and growth is the internal debt

situation the Irish operation has with it's Japanese parent. Mouldco C has assigned a turnover target of £2.4 million for this year.

3.4.3. Education

The company has both Irish and Japanese employed at management level, and with this, obviously two very different backgrounds. The previous owner/founder is now one of the managers in the company. There are quite a few management degree holders, with the design and manufacturing managers qualified in mechanical engineering. The marketing and sales manager has a degree in electrical engineering and has attended courses in management related areas. The company has sent quite a few of the staff on training courses with financial cover. Also the company have held several two day courses in the factory which everyone would be required to attend. Offers of training would not extend to long term courses, not only because of the time constraint, but also because the company holds the view that while it is advantageous to the company to have trained mangers, they do not want them "to sparkle too brightly at the company's expense" and thus make them more marketable to other companies. The company trains new personnel at the Japanese parent plant for three years to provide an emersion in the Japanese culture which it feels benefits in the Irish operations. This training is not confined to any one aspect of the company to ensure the need for interfacing between each department. The was to prove relevant in the Irish plant with marketing and sales having a realistic view of production output and lead-time.

There is one City and Guilds qualified toolmaker in the company, but none studying at the moment. The company views education of the operators and toolmakers with the same logic as it uses with staff, i.e. enough education to perform and complete the job, but not enough to increase the marketability of the employee to other companies in the same field. For this reason, the company would allow operators to take relevant, job-

specific courses, but would not actively promote it. The company did feel that there was a high need for apprenticeship programmes in the company to increase the proficiency of the workforce. The average level of the workforce is leaving certificate standard. Education of the tool makers on new machinery is carried out by the company selling the machine, and the company would also arrange for the operators to see the machine working in another plant. Mouldco C has regularly attends seminars, conferences and associated meetings in it's related area, however, due to time pressure at the moment, the attendance of these has dropped off. The company is a member of The Mould makers Association of Ireland. The company regularly receives publications on topics of interest to it's operations; these magazines are made available to all employees. They have formed links with both Sligo and Dundalk Regional Technical Colleges in the tool making line, in an effort to keep up to date with advances in tooling machinery and design concepts. This use of external avenues serves to maintain the company's edge and ability to solve it's own problem down the road. In doing this, the middle management is trying to circumnavigate the company's perhaps backward view of limiting educational opportunities from within the company for use to the company's advantage.

3.4.4. Current Level of Information Technology

Currently in use are several stand alone PCs and a network. The predominant software being run at the moment is Lotus 123®, which all of the staff would interact with for a number of functions, and a word-processing package. The company would have invested approx. £350K plus in their entire hard & software system, the prompting factor for this was the increasing need for control of finances, wages and production. The system was adopted on the advice of middle management. The level of literacy of computers and knowledge of the systems is adequate for every one to operate the system; there was no formal education of personnel on the system,

operation of the system being based on prior experience and informal help within the office. Middle management, however, would like to introduce a training programme to bring every user up to the same standard and thus improve efficiency of the operation. The design department operates a CAD station, which has direct linkages to the CAM system. The system was acquired when the company had a very basic need for 2-D modelling, but now that the company is requiring full 3-D modelling, the system has shown weaknesses. The company has now recognised the need for constant review and upgrading of both hard and software.

3.4.5. Current Production Management System

The production of a moulding tool is scheduled as a project, with corresponding estimated times for completion of the various stages of the tool. Using this method, the company is able to predict with reasonable accuracy the completion date for a tool and thus a firm customer due date. Due to factors such as overtime and capacity changes, the company is anxious to replace the existing system with a more reliable mode of production scheduling. What the company has acquired a custom written system, but at present is used solely for "recording", as the bulk of the production management is carried out manually, by means of calculating capacities scheduling from the new system's and Lotus 123's printouts. Each machine is scheduled for and biweekly meetings keep the process flowing and inform everyone of progress or problems. Driving the need for the new system was the pressure on the information system in the expanding company, and in the opinion of the sales manager, the system was “a year late in being implemented”. When the need was initially recognised, the moulding division's computer personnel were approached and asked to write a small program to solve the problem. This approach failed, with a year spent debugging the system, and after increasing complaints from the sales and production the system was scrapped and management pressurised to adopt a new system. Advice on the need for the system came from both the moulding division's computer department and from the

various computer suppliers. The selection problem was allocated to the administration section, but as the need kept escalating and no action was being taken, the responsibility was transferred to the production and sales section. These sections then went about arranging suppliers to give presentations in-house, and once the successful system was adopted, the implementation process began. The first major step being the education of the users and debugging of the system, which was beginning to cause confusion from the users.

The cost of the software was £5,000, included full debugging and a thorough user education. The company justified this figure in that the erroneous estimating of a quote could easily result in the company losing price of the system in just one deal. They also realised that the company was not operating in an integrated fashion, with "islands of information existing" and no "collection basket" for all of these discrete packets. The net result of this was that the company could not recognise the full effect of bottlenecks and had to guess at the clearance and cumulative lead times. Now with the new system in place, erroneous feedback from one section can be identified immediately and investigated, with a solution being reached swiftly and without upset to the entire tooling process. An example of this happening was the sales section complaining to production that profitability was not going to be reached if the NC section continued to be working the reported hours. What actually happened was that operators were logging in their own time *plus* the time the machine was running, and the resulting duplication of time alarmed the sales section. With the new system in place this was spotted immediately.

In Mouldco C's case, everybody had different needs and expectations from the system. The accounts department wanted the system to tie in with the payroll system using the clock hours, the production manager wanted the system to provide feedback on the state of production and sales wanted information to calculate whether jobs were yielding profit or not, and to what degree it was. All of the departments were asked

exactly what they wanted, and then the attempt was made to harmonise the requirements together to form the base requirements of the system. The sales/production requirements tied in well, what the accounts and purchasing wanted was slightly different and caused some confusion initially, and when the system was then implemented accounts and purchasing were happy, sales and production were not. The resulting system did give the company a huge volume of information which it had no interest in or use for. The system was then adjusted by the vendors to the company's specification.

It was interesting to note that all of the pressure for the adoption of the system percolated up from below the senior management level and that the senior management took a very weak stance on the issue from the beginning. Management would have eventually acted, but not for at least another year. Mouldco C does recognise that the need will soon exist for the adoption of a some type of production management system to control stock and scheduling, even if it is to be a small stand alone system. The company does not at the moment keep any of it's stock on computer, but would welcome the establishment of such a system. User confidence was restored in the use of a computerised system after the "fiasco" that the company had with the in-house package that was developed, and now the system is trusted and viewed as having integrity. This was attributed to the fact that the "company had an information problem, tackled it, and won".

3.5. CATEGORY 3 (OPERATING PMS) COMPANY EXAMPLE: PLASCO C

3.5.1. Company Facts

Irish operations of Plasco C began in Ireland in 1982. At present it is privately owned, 50% by the American parent company, the remainder an Irish interest. There have been two dramatic stages of expansion and growth, with labour force, floorspace,

product range and bill of material complexity doubling and updating of state-of-the-art injection moulding machines, and the addition of a paint shop and a hot foil station. The driving force behind this was the company's aim to be poised to be to "the forefront of the industry leading into the 21st century" and specialise in certain parts of the market. The outline facts of the company are presented in table 3.5.1.

Category	Estb.	Employment	Turnover	Environment	Quality
Three	1982	170	£8 M	MTO	ISO 9002

Table 3.5.1 - Summary of Company Facts

The company is positioned at the low end of the polymer market, the "buckets and spades" level, which is fiercely competitive and only allows for a very low profit margin; however, the long term plan is to ascend into the upper end market, the mouldings and supply of engineering and medical products. The changing product range is mirroring that of Plasco C's range in the America, that of an increase in health care products, currently at 5% and growing rapidly. All mouldings that Plasco C moulds are used in further assembly processes. The only raw material used is the polymer. All the production is based on specific customer orders using rolling forecasts, with JIT raw material procurement. Customers generally supply Plasco C with their forecast - buying production from Plasco C as agreed. However, this system is not infallible and while the health care business it may be steady, the motor business is "a stop and start situation". Manufacturing lead time can be up to 26 weeks, including the tooling time of the mould, the being operation a three-shift five day basis. Plasco C does not have a R&D department or any production R&D expenditure. Polymer supply lead-time from the U.K. or the continent ranges from 6

to 8 weeks. The company's domestic/foreign customer ratio two years ago was 30:70, whereas now this ratio has been reversed, with 30% of production for export.

3.5.2. Organisational Structure, Planning and Quality

Four people report to the managing director- finance, quality, operations and marketing. Under the control of the operations manager are assembly, production of micro disks, cleanroom, stores and materials handling, tooling, and maintenance. In each of these sections is a manager and reporting to him, a supervisor or senior toolmaker/fitter. In the quality department, the quality assurance manager has an engineer and three quality process inspectors. There is no specialised systems manager, the responsibility of the company's computer systems falling on the operations manager. This management structure is outlined in figure 3.5.2.

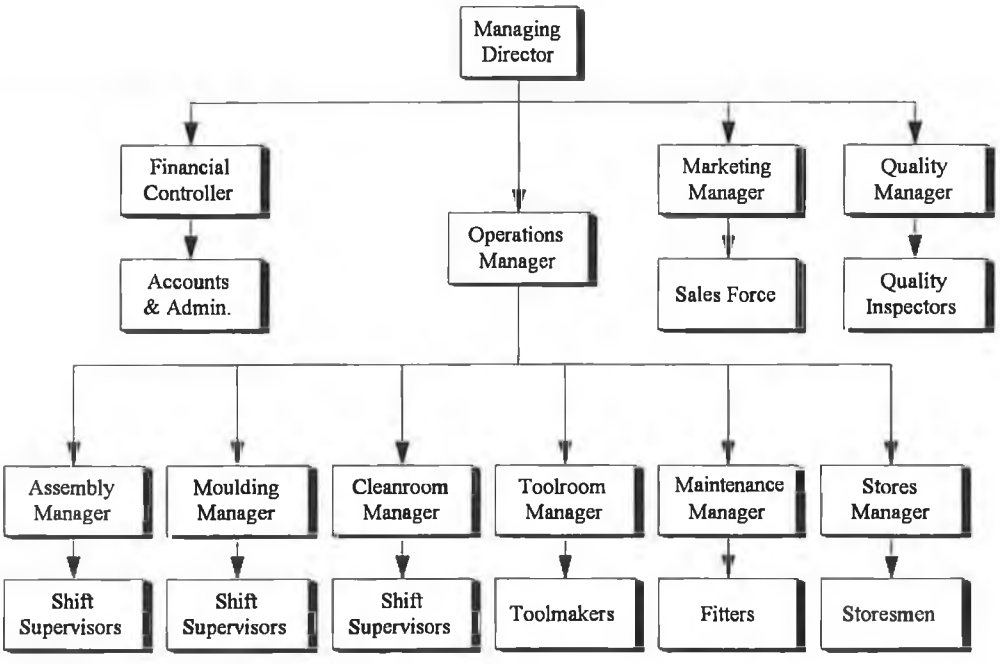


Figure 3.5.2 - Organisational Structure of Plasco C

The process of decision making in the company, is not heavily bureaucratic with good communication between supervisors and managers on all relevant topics, however despite this openness that the company shares with all of its employees, management is reluctant to give too much information to the employees - "just enough information in order to carry out their jobs effectively". Operator input is considered in all areas where applicable, and delegation of authority is encouraged in all areas. Plasco C has a business policy stating that it wishes "to be the best" in the technological field of injection moulding. As part of this it aims to upgraded all it's moulding equipment, mould exchange and component handling, its production process and its information handling. The upgrading of the moulding machinery and mould tool and component has been realised after extensive investment and operator education; the implementation of the information handling system is currently undergoing review. The company does have a formal one year business plan that ties in with their financial plans; augmenting this is a three year business plan, which the company was "forced" to state for IDA grant aid purposes, and has very specific long term goals that it is currently following. Plasco C feels that their standards far exceed anyone else's. They have ISO 9002 since 1986 and they feel that they will be pushed towards world class standards and WCM as both their internal and customer demands getting higher and higher. They have several Ship-to-Stock awards and the Quality mark.

3.5.3. Education

The bulk of management and staff have come from a third level background. The managing director has an engineering degree and a MBA, the operations manager also has an engineering degree. The senior technicians all qualified. The company gambled by employing local settled people, training them and promoting them, risking the case where an unqualified employee might be promoted from a level of adequacy to a level of incompetence, rather than graduates who would have a higher tendency to leave

after absorbing the company's time and money. This gamble has paid off for Plasco C and as a result the company now has long term assets in junior management. The company actively encourages the attendance of educational courses. At present, one of the managers is studying for a degree in industrial relations, while three others are engaged in long term courses. There has been a lot of attendance by staff at shorter courses. The company subscribes to all the major trade journals, and attends regularly related seminars and workshops, however it does not attend "every dog fight". The average level of education at operator level is Leaving Certificate. The company strongly encourages educational courses in related areas with full financial support, and have found strong interest in further education The company has established an internal formal training programme for all the employees as a result of the company's strong belief in education.

3.5.4. Current Levels of Information Technology

The company began their introduction of computerised systems in 1983 with one PC. Following this a Novell® network was introduced, and after this a Micro VAX. The quality assurance department implemented an on-line QC monitoring system running on their own network. In all there are between 25-30 terminals in use throughout the company, both on the operations floor and in all offices. All staff interact with the system except for three who have a "love-hate relationship" with computers and decline to use the system, mainly due to their lack of confidence in the use of computers The decision to purchase the hardware was based on the decision of the company to build it's system using established computer equipment, i.e. IBM and Digital. While this was more expensive than other models available, the company felt that it made economic sense as they were assured that IBM and Digital would be available for service while the other companies might flounder. The company has invested £200,000 to date on hardware and software. The non-PMS software the company uses consists of Word Perfect®, Lotus 123® and Harvard Graphics®, and a

CAD/CAM system. If the operators feel they need further education on a new or existing package the company will ensure they are fully trained. Also in use is custom software developed by a local company. The decision to go with a local company was due to the fact that as payroll and accounting systems are tax based, there was the need to have a system that could be modified for the Irish tax system. It also meant that backup facilities are always readily available. The internal writing of software is discouraged, as there is the fear that the author of the software may leave the company, and with the likelihood of detailed software documentation very low, the net result could be a system that nobody can maintain.

3.5.5. Current Production Management System

The same company that wrote the software for the payroll and accounting also developed system software for the recording of mould settings, employee efficiency and personnel department software, and SPC and quality statistics software for the quality assurance department. There was no specific plan set up to implement the production related software, instead the system just got added to and "trickled" in over time; however, this has now lead to more formal approach as the company is planning a second quality network and a bar-coding system. Investment in the system has always been forthcoming, with the company recognising that there *are* financial benefits involved in the operation of their CPMS. No resistance was met at any stage of the systems implementation, as Plasco C has established a strong sense of technological awareness in it's workforce, this fact being reflected in the willingness to learn the new system and the confidence to fear no part of it as a threat to jobs. This was clearly demonstrated in the past when the implementation of a robotics system was introduced into the company, and they surprised management by working with it and learning easily about the system.

The current system operates on a spreadsheet, database interaction to great effect. Detailed forecasting is carried out up to 13 weeks in advance and the system is rigorously adhered to. Sales and estimation are operated on the spreadsheets, whereas the financial package can look after the stock control and maintenance. While the company is not totally happy with the system, "it works and it satisfies and convinces customers that (the company is) in control". The company recognises that in acquiring any package a degree of compromise is needed, as you will never get exactly what you want the first time.

The company was involved with a software house in a project to determine what an ideal industrial monitoring software package should contain. In doing this the company evaluated their existing manufacturing system in detail in order to identify their requirements. The title of the BRITE funded project was *Predictive Control Techniques*, and Plasco C was to be used as a test site. The ideal situation that was proposed was that everyone involved in the operations process should be given full access to all production related information, a concept that Plasco C's operations director disagreed with. The consideration of such items as personal keypads, and touch screen menu facilities were all considered, but the project in Plasco C never got off the ground due to financial cost for the system.

The company has had a relatively easy transformation though to category three via the various stages and Plasco C has demonstrated that an effective system can be operated and handle the day to day running of the plant without having to be a fully integrated system. The fact that their system is not fully integrated is not due to financial pressure or lack of knowledge, as the company seems to have no problem with either of these two areas, but simply that the company developed a system that suited their needs rather than adopt a system that the computer company would convince them that they needed.

CHAPTER FOUR

DISCUSSION AND ANALYSIS OF CASE STUDIES

4.1. INTRODUCTION

This chapter examines closely the information gathered from the case company profiles presented earlier. The data from the fifteen cases are reviewed and the barriers to the effective adoption and implementation of PMS are identified and analysed. The analysis is guided by the thematic headings that were developed through the conceptual framework format from the three literature strands reviewed and discussed in chapter one. This chapter also discusses the nature of the case companies and their category representation, and the progression of the companies through the stages or categories to their present state.

4.2. CATEGORISATION OF COMPANIES

Each of the companies were categorised into the three categories discussed earlier (summarised in table 4.2.1). What became apparent for the case companies upon data collection, was that the initial assumed categorisation of each of there companies in the five sectors was not reflected in their level of PMS; i.e. when the companies were examined in detail it became clear that some of the companies did not meet the requirements of the specific categorisation it was assigned. What resulted from the fieldwork was an alteration of the theoretical stratification to portray the actual stratification as represented in figure 4.2.1.

Category	*Definition*
1	Non-user of a formal PMS
2	Ineffective user of a PMS
3	Successful user of a PMS

Table 4.2.1 - Category Definitions

The stratification of the companies into the three categories was based on the initial presumption that companies progressed through these phases in order that the third successful category could be reached. In some cases it was difficult to categorise the companies, in that the company although meeting the requirements of that particular group, might show characteristics more reflective in the category above or below it. The companies in question were Plasco B and Foodco B, who due to their management styles and approach to the introduction of their second PMS, were more akin to category three companies, but as they were not operating a successful system yet were consigned to category two status.

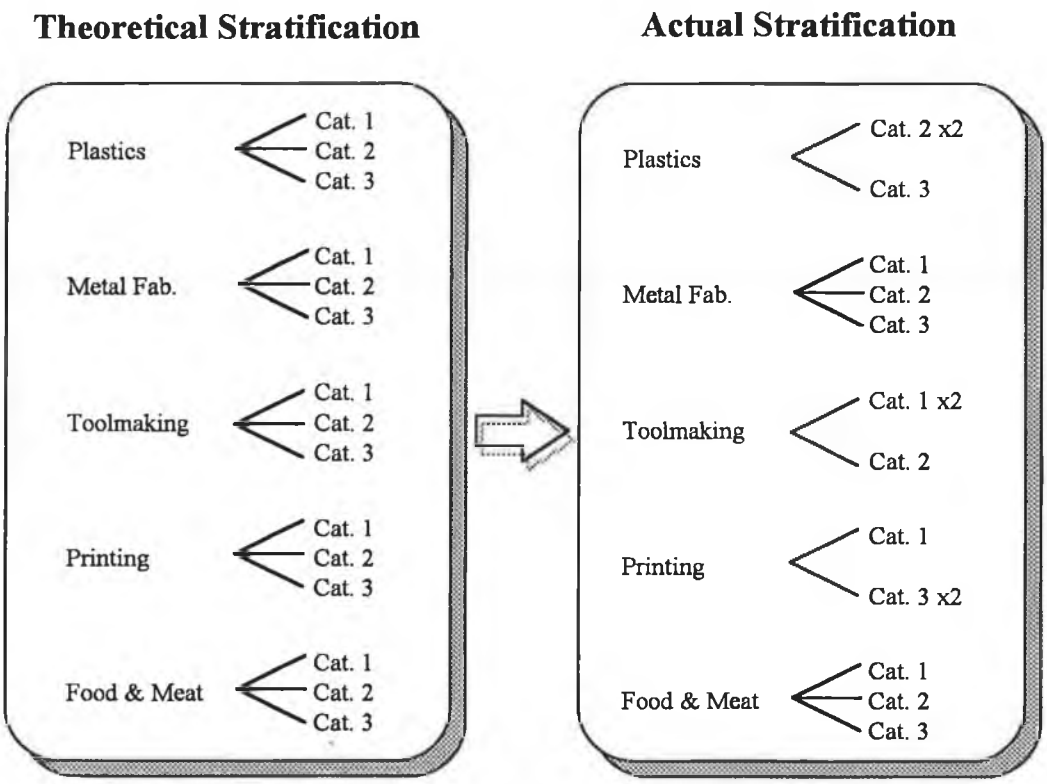


Figure 4.2.1 - Actual Stratification of Qualitative Sample

This deviation from the expected categorisation did not have an negative effect on the research design, nor on the data interpretation stage.

4.3. COMPANY EVOLUTION

The initial premise was that the companies evolved with their systems through the categories one through to three. The research was investigating whether any evidence could be found to demonstrate the progression of a category one straight through to category three. Figure 4.3.1 illustrates this process of evolution.

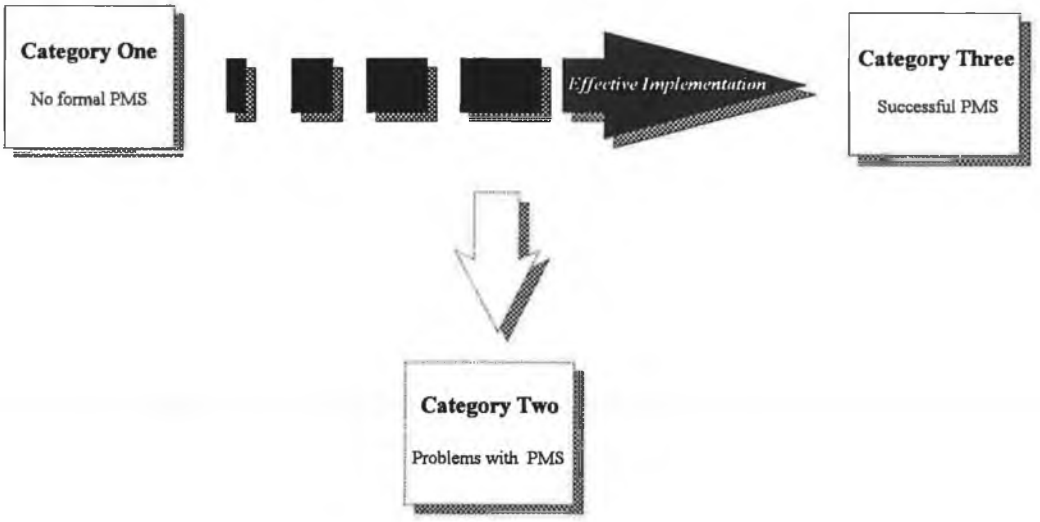


Figure 4.3.1 - The Ideal Transition.

One of the most striking findings was that of all category three firms had evolved through category two stage - following a progression through phases as shown in figure 4.3.2, thus suggesting that all pass through the category two phase at some stage. While it is recognised that this category two stage is an expensive trial-and-error stage with the risk of the company never attaining full implementation (category three) status, this suggests that it is a necessary step. Thus the next area to identify was how companies minimised the category two stage and hastened their progression through it. Indeed in some cases the

companies remarked of actually profiting from the experience and also learning from it.

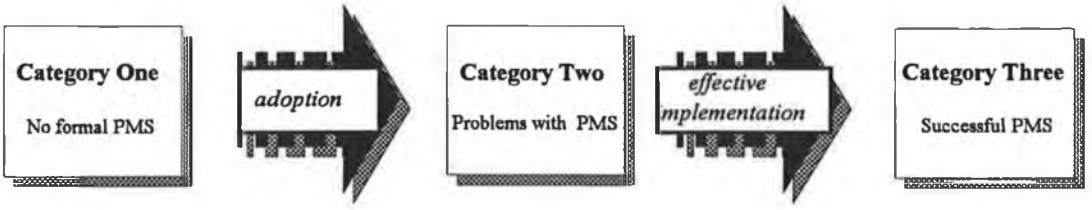


Figure 4.3.2 - Stages of Evolution.

This has been substantiated by the fact that of all of the category two and three companies who had experienced previous systems failure, none had any reluctance to try to re-adopt a new system, they were, however, obviously more careful the second time round. All of the category three companies attributed the success of their operating PMS to their previous system's failings, (- their time spent at the category two stage). The previous system had served to tell them exactly what they needed and were without in order that they may manage their operations competently.

4.4. MAJOR THEMES FOR DISCUSSION

Of all the impinging factors that emerged from the company data, several themes came to light reflecting those discovered from the review of literature. Of these themes, several were found to have strong effects on the outcome of implementing and operating a PMS in a company, while others had a minor effect on the PMS and it's usage. This section deals with the major themes outlined in figure 4.4.1.

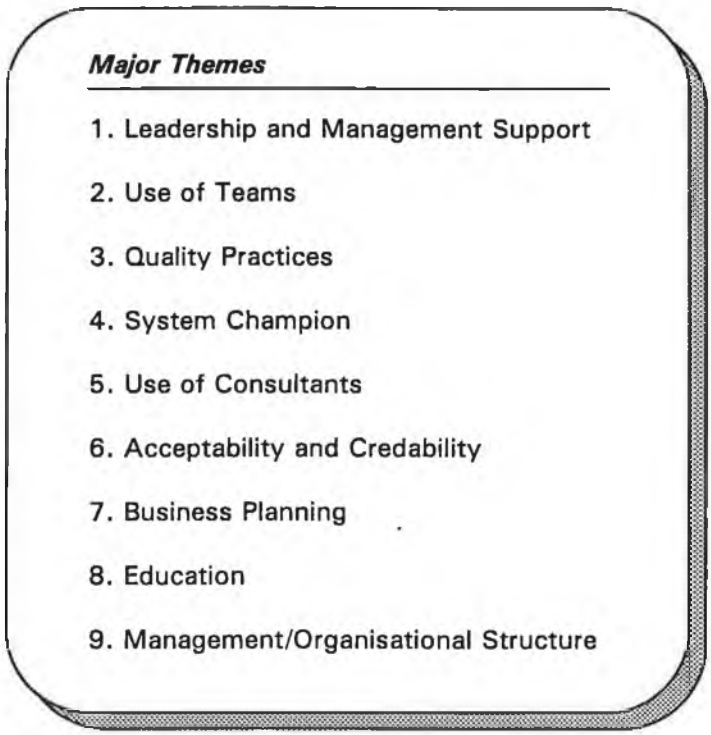


Figure 4.4.1 - Major Themes for Discussion

4.4.1. Leadership and Management Support

What made the systems succeed in the borderline category two (Foodco B and Plasco B) and category three companies (Plasco C, Foodco C, and Fabco C) was the existence of senior management's belief in not only the need for a system but also in the adherence to the system's procedures. Category one companies remain at their level of production planning because the senior management do not want a formal PMS in operation in their company. A factor undermining the commitment of top management, particularly of owner entrepreneurs, is the fear that control or influence over particular types of decision making might be surrendered to the system. Stanworth and Gray (1991) cite Bolton (1971) in support of this strong need of owner/managers "to attain and preserve independence". This rational is not just confined to the owner/manager but may be extended to other areas in the company. The company purchasing planners may feel their role undermined with the

introduction of a new "user friendly" system, and consequently may actively or otherwise resist the systems introduction by denying it any support.

This was found to be true in all three category one companies, certainly so in Fabco A and Foodco A where the owner/manager resisted any opportunity to introduce a formal procedurised PMS. In the case of Mouldco A, it was because the top management of this company consisted of a board of directors *none* of whom wanted such a system - "we don't consider it an issue at this stage".

In the case of category two companies, in all but two of the companies, they regarded the success of the PMS as a priority B exercise that could be dealt with when "(we) have less on (our) plate, and more time for all those things that have to get done", to quote one manager Mouldco B. When Pfeffer's (1992) work, where he states that leadership and management are intrinsically tied in the initial stages of a project, is applied to these two categories, it becomes clear that there was a combination of a lack of authority from top management, a lack of co-operation from other management and department areas, and an element of incorrect leadership (Fabco A).

4.4.2. Use of Teams

Few companies had formally formed teams to implement a PMS into the operations of the company, contradicting elements of Roa's (1985) model for the implementation of a PMS, where he has a specific organisation phase which he claims is the most crucial to the implementation projects success. Yet many had experience of team work due to the adoption of formal quality standards such as ISO 9000. There did not seem to be a definite reason for this lack of team work towards getting the PMS up and running within a company, perhaps

this was due to the lack of management commitment.. This lack of management support would explain why teams were successful for the implementation of a quality standard - a standard that all companies surveyed were positive about, and why few teams were used for the adoption of a PMS - a tool which most management did not back.

To address the issue of the team concept not getting the support of management Hartley (1989) suggests that an executive steering committee should be formed, with full control of the project team, with an executive committee providing backup and control with active leadership, provision of staff to the project team, defining the project scope, insuring management commitment, allocation of resources, review of team and project progress, and the attending of top management education seminars. Yet this was found only to exist in the more advanced category two and all category three companies, particularly in the case of Mouldco C, Plasco B and Plasco C where the use of teams to implement the PMS were formally formed and used with success. Indeed these companies' teams were representative of what Beatty (1992) referred to as 'cross-functional teams', with the implementation steering committee being composed of members representing various departments in the company; a view reinforced by Ettlie & Riefeis (1987) when they discuss having active integration between system design and manufacturing, both of which were represented on all of the teams. In evidence in Mouldco C and to some extent in Plasco B, was the carrying of the existing functional structures present into the team structure and thus into the implementation of the system without thought for integration. This served to create a situation of various parts of the team pulling in opposite direction towards their own individual goals rather than the overall company goal.

4.4.3. Quality Practices

The use of quality practices in companies served to allow the company to examine it's style of operations and analysis through establishing procedures, every step of their operation. It is because of this that companies that are currently engaged in the adoption of ISO 9000 principles or have been ISO 900 certified, recognise the level of planning needed to adopt a new aspect into their operations, and the need for further control over each step of their process with traceability and accountability. No category one company had begun to consider it's adoption, although two companies (Mouldco A and Foodco A) recognised that it might consider it's adoption further down the road. The result of this is that the companies have no way of recognising the need nor have a need for tighter process control.

Category two companies look on the gaining of the ISO 9000 award as more immediate, tangible and successful to the company and have tended to put the adoption and implementation of the PMS in the back seat as a priority B exercise. Also it makes the adoption of a new system more difficult as the system will have to be to be documented, but also, as in most cases for the system to really work, there may be some alteration to the existing process needed. One of factors preventing PMS adoption or alteration is that the current process already procedurised, and thus the company may be unwilling to change and reprocedurise. This may manifest itself in the extreme - the risk losing their ISO 9000 certification, thus the PMS introduced will not be configured to it's optimum operating level and full implementation cannot take place - resulting in an unsuccessful system. Category three companies without exception all have quality programmes, and what's more, have their PMS incorporated into their operations procedures. This has served to ensure the systems success as each step had to be examined and documented.

4.4.4. System Champion

As the review of the literature presented earlier, a system champion is an individual within the company that believes in the merits of a formal PMS and will thus work towards the implementation of such a system. The case studies proved the advantages of, if not the need for, such a person. Among the category one companions, such an individual was found in only one - Fabco A. The production manager in Fabco A seemed to be the only member of staff in the company that recognised the need for such a system, indeed it was he who had tried to introduce some element of formalisation into the existing method of operation. In the remaining two category one companies there was no evidence of such an individual present. In four of the seven category two companies there was evidence of the existence of a system champion. Two of the remaining three, Plasco A and Mouldco B appeared to have no one individual intent on seeing the success of a new system or a solution to the existing one. Foodco B did not on the face of things have a lone system champion, but rather it had a strong managerial commitment that replaced the need for a lone system champion, the result of this being that the obvious and natural choice for system champion was acting more in the role of implementation steering committee chairman.

Of the remaining four, Mouldco C, Fabco B, Plasco B, and Printco A, the system champion came from a variety of positions: financial controller (Plasco B), production manager (Fabco B), marketing manager (Mouldco C), and assistant production scheduler (Printco A). A thought provoking point is made by Howell and Higgins in that if organisations formally appoint an individual as 'their champion', the possibility exists that the company's formalisation of the role could actually lead to its disappearance.

There was no evidence of champion failure as Beatty (1992) had found in her work. In all cases the champion had had to confront senior management and attempt to convince them of the need for working with a new system. What made the difference with the category three companies was the fact that all of the champions of the system were senior managers or directors in the company. In the case of the two most successful companies in the third category, Printco B and Plasco C) the two system champions were the operations directors with direct input and influence into both the production and company-wide policies. Both these people were directly responsible for the system within the company's operations.

4.4.5. Use of Consultants

The use of and views on the use of consultants varied between all of the companies, but there was one underlying attitude throughout all of the interviewed companies and that was a negative, sceptical one. Category one companies were found not to use consultants, however as mentioned by both Fabco A and Mouldco A services offered by the IDA and Forbairt satisfied any need that they might have. However, there was very much the mentality of the owner/founder/managing director in place that would shun any outside consultancy advice.

Category two companies were more in a position to use consultants, yet only two of the seven companies used consultants as an aid to their system evaluation and adoption. These companies Plasco B and Foodco B were not satisfied with the advice or the service that they received in the area of their system, and would welcome using personnel external to their company but not under the present structure of consultancy. Plasco A was using the services of a

consultant under an IDA executive development programme, although the consultant was not operating in the area of systems adoption or exploitation.

Of the two category three companies Fabco C and Printco B that had used consultants, they had no complaints of their usage, this can be attributed to the fact that the use of the consultant was tightly managed, and results expected within the agreed time limit. Of the remaining three companies, only one - Foodco C expressed a dubiousness toward the use of consultants although admitting that they would be prepared to use them, but this reaction portrayed a very sceptical attitude toward their use. The fact that neither Printco C nor Plasco C reflected more their ability to cope with the system implementation themselves rather than their reluctance to use consultants.

4.4.6. Acceptability and Confidence

What was very necessary was the need to establish confidence in the system. this confidence was needed in two different guises. The first was to establish confidence in the use of computers functioning in the business, the second in having confidence to the system generating works orders and schedules. On the first point, that of establishing confidence in the actual use of the computer system in the company, a situation was in evidence in Fabco A whereby the only computer in use was for the purposes of book keeping and it was operated by a part-time contract book keeper. The managing director in the company refused to introduce computerisation, believing that it could not justify its cost outlay and would "not suit" the companies style of operations. In the words of the production manager, "he was afraid of computers", and to this end vetoed their introduction. In the case of Foodco A, neither the managing director or the operations manager could see how their company could benefit from the

introduction of computers and the augmentation or replacement of their current manual journal style PMS system.

On the second point, that of having confidence in the system, there were examples of this encountered. In one of the metal fabrication companies, Fabco B, the company had a full MRP system installed that used solely as a tool for defining the BOM for each job on the floor. When questioned on this, as to whether or not there had been a serious problem, the production manager responded that "they just never bothered using it". This demonstrated a reluctance to exploit the MRP system, as there was either little confidence in its abilities and a fear of losing control of operations if the system went fully live. In Plasco A the case also existed of relegating the production system to be used purely as a check against the manual system. In the case of category three companies, they all had total confidence in their systems, with senior management prepared to accept and act on generated system information.

4.4.7. Business and System Planning

When the planning practices of the companies were explored, the formality of planning across the categorisation became clear. Companies that didn't plan for system integration risked isolated islands of incompatible information, thus reducing the technology's benefit (Beatty, 1992), and Wight (1981), Landvater (1981) and Roa (1985) all stress planning as critical to successful system implementation. Category one companies tended to have no, or only very short planning horizons, while category two and three companies generally had 3 or 5 year plans. The reason that category one and some category two companies had no, or short, planning horizons was attributed to three main factors:

(a) Poor management of the companies with lack of foresight.

(b) Lack of confidence in planning beyond the longest planning horizon, market led planning. (Mouldco A, etc.)

(c) Lack of capital or funding available (higher risk) to commit to anything over twelve months.

This agrees with Stoner's (1983) findings that SMEs to practice only short term planning, with SMEs rarely have formal strategic plans. The consequence of this is that companies (all category one and some category two) were not prepared to undermine their current operations and replace them with a system that would take longer than their planning horizon to implement. This fear of entering the unknown was found to be true for Mouldco A and Fabco A. Also the fact that as they had not ever planned for anything before using a medium/long term plan, they could not compare or liken the task to any previous similarities (as with Fabco A).

Of those companies that had formal business plans in use, they had different approaches to the length of their operations planning horizons, varying between 12 and 60 months. Table 4.4.7.1 presents these planning horizons by sector.

Sector	Cat.	Planning Horizon
Metal Fabrication	1	None
	2	"as parent"
	3	5 years
Toolmaking	1	None
	1	5 years
	2	5 years
Plastics	2	2 years
	2	1 year
	3	5 years
Printing	2	1 year
	3	5 years
	3	5 years
Food	1	1 year
	2	3-5 year
	3	3-5 year

Table 4.4.7.1 - Planning Horizons of the Studied Sectors

Some of the category two companies used a one to three year plan. This level of planning would have become a consideration due to the implementation of new technologies such as new lines (Foodco B), quality practices (Plasco A), and plant refurbishment (Mouldco B, use of CAD system). This originally allowed for the introduction of the PMS, but did not allow for sufficient planning of education, debugging, etc. to ensure its success. (Mouldco C and Printco A). They had also had the benefit of planning for a quality system and standards attainment, and in one case major market expansion (Foodco B) which were major exercises in planning for company improvement.

Category three companies planned effectively, all of the companies having long term business plans and having a set and achieved previous goods. This instilled a belief in the companies that they could carry out and achieve the goal of successful PMS adoption. Due to the available capital to category three companies, some (Fabco C, Printco B) had used consultants and this gives greater though to the planning process involved. It must be recognised that generally, as the category three and some category two companies had passed through the stages and acquired these skills along the way, this increased their ability to instigate and use business plans which invariably entered in to other areas beyond PMS.

4.4.8. Education

Work carried out by Waterlow and Monniot (1986) addresses the area of learning curves for the implementation and operation of computerised PMS. In their work on a study of the state of PMS in use in British SMEs, they found that the learning process for the use of PMS was no different from that of any other new technology. They cite three dominant, interactive factors in learning curve success - organisation, attitude and technology. This is illustrated by

figure 4.4.8.1. This model implies that methods of education of other technologies may be applied to the education of users on PMS with the same certitude of success.

Figure 4.4.8.1 - The Three Dominant Factors in Learning Curve Success

It is the average education levels of the management not of the operators that is the factor that proved to be an element here. The data from the case companies demonstrated a trend that companies with engineers and graduates within middle to top management had more successful systems in operation than those which had none. An explanation for this would be that the managers that had be educated in college would have been exposed to the applications and advantages of a structured and computerised systems. There would not be the same degree of apprehension towards new technologies or fear of, for some, the unknown qualities of computerisation. Another aspect to this is the age grouping of the graduates in these companies, which tended to be under 35 years. In 1982 Rowan's view of people in business who daily interface with computers was that they were younger, articulate, more egalitarian, less traditional and more loyal to their computers than to the company. Over a

decade later this view could be said to have considerably changed, but in essence parallels can be found in the findings, as they prove that the younger and more recently educated (consequently in computers) the manager, the more receptive he is to new technologies and their benefits. Because of this there is not the problem as expressed by some management that were interviewed who claimed that they were of a different generation to computerisation.

Once the management were sufficiently educated in and fully aware of the system, the education of the floor operators did not seem to be an issue. No company which had undertaken a education programme with the staff remarked that the operators were unable to grasp the system's operation - rather the problem lay with the quality and length of the training course or the system documentation. This sentiment is also expressed in the broader, Irish sense by Culliton (1991), when he asserts that management training has received inadequate attention in many Irish firms. Millard (1989) found typical education and training problems in relation to computerised information technology. These included that the training often begins before needs are established, that the training is not specific enough to the system, that training materials are inadequate, and that system design considerations are not adequetly considered. There was no evidence to support the first of these problems, but the remaining three were found to exist in the category two companies represented.

4.4.9. Management / Organisational Structure

Category one companies by nature of being small, reasonably new (exception Mouldco A) tended to have a single owner/founder autocratic figure at the helm. The effect of this on the company's use of computerised or formal system therefore hung around the sole neck of the owner. Figure 4.4.9.1 is the

organisation structure of one of the category one companies and was found to be indicative of this category. Generally, the owner/founder tended to shun the use of a formal control system, as in the case of the managing director of one category one company who "doesn't trust computers....", and another who remarked that "we are a generation behind" - and as such find it difficult to actively encourage computer usage.

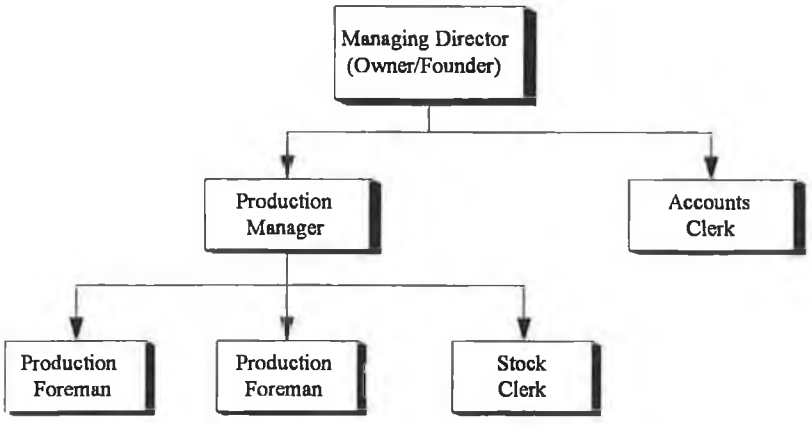


Figure 4.4.9.1 - Category One Company Organisational Chart (Fabco A).

Demands from the floor in category one companies were generally unheeded as the predominant power resided in the top layer, thus preventing any initiative from the junior managers or production supervisors/managers. This organisational structure does not allow the possibility of the system champion emerging other than the managing director.

The predominant structure of a category two companies is illustrated by figure 4.4.9.2. For the sake of representation, the company type represented in figure 4.4.9.2 is that of one of the printing companies, with the various departments represented. This departmentalisation was found in all of the category two

companies' management structures, for example lithoprinting and laminating (printing sector), moulding and tooling (plastics sector), and tooling and high volume production (tool making).

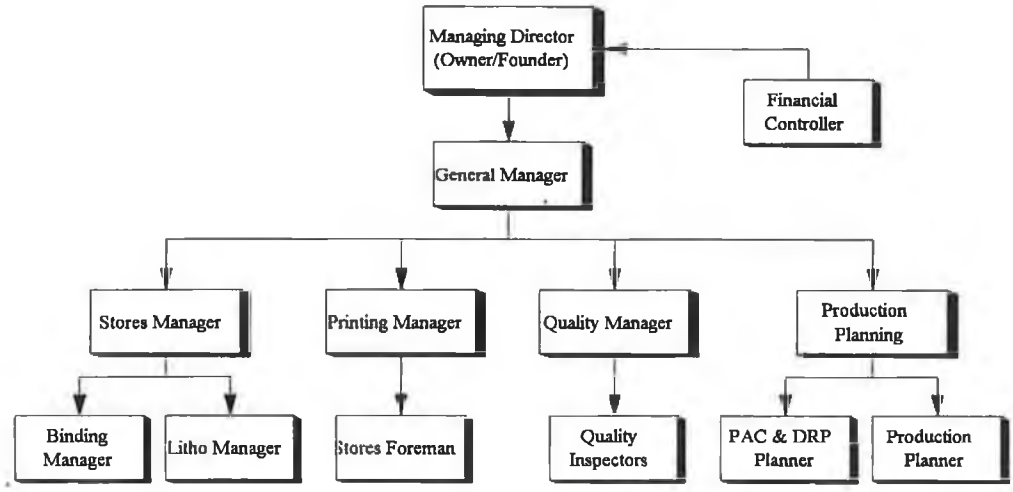


Figure 4.4.9.2 - Category Two Company Organisational Chart (Printco A)

Category two companies, having emerged from the category one phase, still tended to retain some elements of the autocrat at the helm. Evidence of this was predominant due to the fact that the same person that had managed the company was still in a position of power, and while there may now be a supporting structure below, major decisions were still dealt with by him. This had an obvious effect on the introduction of a PMS, and among other things hindered the emergence of the system champion, and junior to middle management initiative. It also increases the risk of stubborn gatekeepers, blocking the path of PMS implementation proceeding within the company, as was found in (Printco A).

Category three companies tended to have a much flatter, broader management structure, with more power and decision making being delegated to the second

tier in the structure. Figure 4.4.9.3, a category three plastics company, represents a structure typical of category three companies.

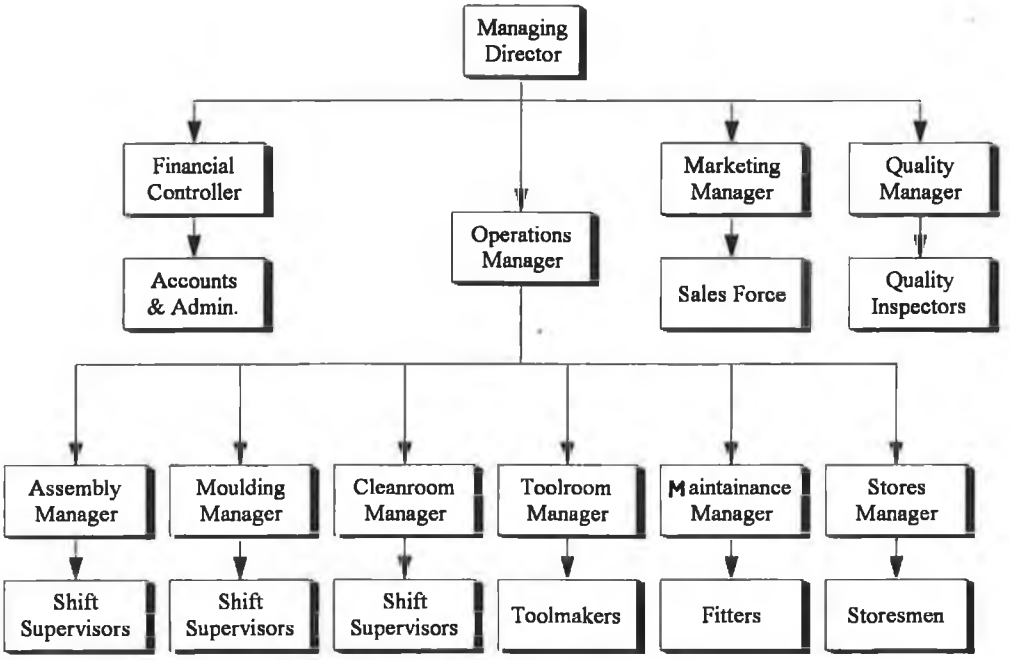


Figure 4.4.9.3 - Category 3 Company Organisational Structure (Plasco C)

The use of a well-defined and structured organisation meant that each department understood its own needs and with intelligent liaising with other departments, allowed a suitable company-wide PMS specification to be devised. Champion emergence, and more importantly champion encouragement, was found to easily occur in this system and the formation of steering committees or project teams, as in the case with Plasco C and Printco B, could also emerge.

4.5. MINOR THEMES FOR DISCUSSION

While the themes above were found to have dramatic effects on the operational success of the PMS in a company, there are several others that, although not important individually, combined serve to have quite an effect on the outcome. These factors, presented in figure 4.5.1, are discussed here.

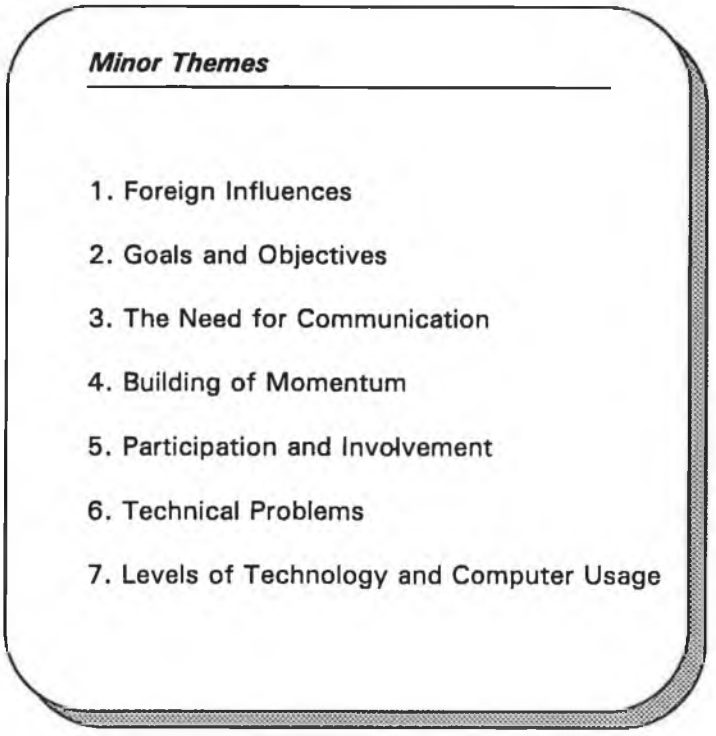


Figure 4.5.1 - Minor Themes for Discussion

4.5.1. Foreign Influences

On the issue of the nationality of ownership of the surveyed companies, five companies were owned by foreign companies, - Mouldco C, Fabco B, Fabco C, Plasco B and Plasco C, and one had merged some of it's operations with a English concern, (Foodco B). The effect that foreign ownership had on these companies was quite varied. In the case of Fabco B and Plasco B, the initial systems were recommended by the American parent, but as the company outgrew them it became the responsibility of the Irish operation to choose the next generation they were to use and implement their choice independent of the parent. Plasco C, one of the most successful of all of the companies in terms of system success, received no pressure or guidance from their American parent, but rather on the positive side did receive education and training courses in the area of production management and current trends in PMSs in the United States. This was also true in the case of Fabco C, and to some degree Plasco B

which made use of training courses and expertise of the larger parent, or parental influence. While in some cases this may seem like imposed solutions thrust upon the company, the general experiences of those who received help form their parent was that it was constructive and welcomed.

4.5.2. Goals and Objectives

Evidence of the use of goals as targets in the planning and implementation of projects within the company was found in most firms, but at varying levels. The category one companies tended to have short term goals reflective of their planning horizons, such as Mouldco A's acquisition of a new CAD station and expecting it to become operational within a month. Fabco A and Foodco A both had no goals in terms of equipment, new markets, or profit increases. This reflected their attitudes towards introducing a PMS, in that the goal of introducing a PMS would push out beyond their planning horizon and consequently they would not address it..

Category two and category three companies displayed using goals in their operations as a means of achieving better operating efficiency. This included such goals as ISO 9000 attainment, new CAD systems, and in some cases PMS implementation or improvement. Most noticeable of these in the category two sector was Foodco B which as part of their business plan had goals set out to achieve to aid the implementation of the impending system. Their approach followed that advocated by both Landvater (1981) and Wight (1981) who divided the full implementation of MRP II into a series of steps, further divided into individual tasks, each with a recommended time for completion. These become the short term goals that must be achieved in order for the next step to progress effectively. As part of Wight's minor goals, some of them include the need to reach certain precise minimum efficiency and accuracy levels (for

example having a 98% Bill of Materials accuracy level), a step Metzger (1984) disagrees with claiming that a little improvement is better than none at all, that there is a "middle of the road approach" that should be used.

At category three level, Plasco C had pursued the goal of attaining an industry leading quality and dependable PMS for use within the company. This was carried out through a series of achievable goals at various stages along the implementation plan. The remaining companies in category three had also to a minor degree used clearly defined goals with success in achieving their objectives of an operational PMS, illustrating the fact that end goals are an important aspect to the PMS implementation process.

4.5.3. The Need for Communication

In order that the need for this is best illustrated, it is useful to compare two companies and their approaches to inter-level communication. In the case of Printco B all of the system operators were regularly asked for their input into the operation of the system and what could be added to, simplified, changed, dumped for the system in order that the system could be more easily followed in the everyday running of the plant. In this case all of the operator input was considered, heeded and evaluated. In the case of the other company Fabco C the operators were not considered or consulted as to their expectations or gripes with the system. This went to such an extent that the operators and shop floor personnel interfaced only visually with the system and there was no degree of trust given to operator input on the floor in using the system.

4.5.4. Building of Momentum

The building of momentum is achieved through the use of effective communication, involvement and the skills of the project champion. Because

Metzger's (1984) theory is based upon small amounts of success on a regular basis to increase this momentum, it is therefore vital that the route that is to be taken is the route that will ensure early successes and thus, the easiest modules first. This was only practised in one of the companies interviewed, Mouldco C, with its replacement system and was found to work well, serving to break down resistance and get instill confidence in the new system.

Metzger (1984) also noted however that it would be quite easy for the reverse to occur, i.e. the failure of a module to build up resentment and resistance to full system implementation. There was evidence of this found in the cases of Fabco B, Printco B and Plasco A. The factors that Metzger attributed such as age and ability of the workforce, its attitudes, and individual behaviour as influential on progress of the system adoption, were not found to be displayed from the information received from the interviews.

4.5.5. Participation and Involvement

Active participation by both management and operators was found in relatively few of the 15 companies, the exceptions being Printco B, Printco C, Foodco B, Foodco C and Plasco C. Floyd suggested that an emerging 'paradigm change' can be said to be influencing systems engineers. This change involves an evolutionary, user-centred employee supporting perspective instead of the conventional static, program-centred and employee-replacing one (Blackler and Brown, 1986). The companies that did not view the system introduction with this user-centred employee supporting perspective did not succeed in creating a mass of interested employees interested and supportive of the system, for example Fabco B and Mouldco C's original system. Indeed it is interesting to note on this point, that as part of the existing law for industrial democracy in

Sweden, employees' influence is guaranteed by their participation in decisions (Brunsson, 1982).

Patrickson (1986) researching employee adaption to new technology, relates that the potential negative impact associated with the introduction of computerisation can be mediated by a number of factors including, as one in particular - employee participation. The findings from the case companies found this to be true in that the five companies that did have active employee participation are among the five companies with the most successful PMSs in operation. The process encouraging involvement of everyone is quite similar in all of these companies, with open communication and strong communication links between management and supervisory levels and operators.

4.5.6. Technical Problems

Their were many technical problems encountered by the case companies during their system implementation. However, the bulk of these were attributable to the system vendor/company interface and not the actual system itself. Thus "pure" technical problems were not cited often or revealed during the interview stage. Of these few, the most prevalent was a problem also found by Beatty in her work in America. She found a major problem to be that of incompatible systems, and cited many reasons that can explain how easy it can be for a company to end up in the situation of having an incompatible system. Apart from failure to plan effectively for a standardised system, one of the prime reasons that she quotes is the fact that the constant sate of flux and technological improvements, makes it hard for the small company to plan a growth system.

On the issue of the system vendor/company relationship, she addressed it by suggesting that companies should consider "shopping around" to a few vendors, increasing the risk of system incompatibility, or to stay with one and run the risk becoming tied to the supplier and facing problems if the supplier goes out of business or decides to increase prices. The problem of technology superseding itself is also a risk, although this only happened to one of the companies - Fabco C initial system.

In the case of Mouldco C's initial system, there were some initial problems of too many departments having too many requests of the system, the implementation proceeding simultaneously with all departments resulting in technical chaos with the software crashing. Metzger (1984) advises a method of implementation that will alleviate this. By delegating the control of the system to one department, it is isolated to this single, specific area and thus the problem of overlapping in to other areas, such as purchasing, marketing and finance is minimised. This isolation also serves to keep the possible implementation problems in perspective, and avoids the confusion of the implementation of MRP, shop floor control (PAC) and a new purchasing system that will arise with personnel over the areas of control of each function.

4.5.7. Levels of Technology and Computer Usage

In category one, the companies represented all had low technology, single step operations, with no great need for process control. Mouldco A, although a tool shop, remains a low user of technology, and only recently considered acquiring a CAD station. The low use of technology means that the company not only has no use for high levels of control, but has no technology to precede the adoption of a new system. This has been echoed in the cases of Fabco A and Foodco A. In companies in categories two and three, this does not tend to be as great an issue as there is a high degree of CNC machining, robotics, and micro

processors controlled machinery. Coupled with this is the increasing use of computers for specialised functions in the production sequence, such as page layouts in the printing industry, CAD/CAM in the metal fabrication and higher toolmaking sectors, and some mould flow simulation in the case of the plastics sector. But there is an important difference with these systems and PMS in that these systems are single function, dedicated applications with direct and singular training, not the broader, all-encompassing attribute of a PMS.

4.6. APPLICATION OF A COMMON IMPLEMENTATION MODEL

The most widely used area of literature by companies implementing a PMS is the technical productions and operations field. Taking a widely used method of PMS implementation as a general yardstick and applying it to the case study companies, allows deviations from the plan to become apparent and mistakes to be more obvious. This enables the examination of the practice used by the companies surveyed in their implementation of their systems. In the case of category one companies, by virtue of the fact that there are no systems in place, none of this plan, or indeed any other apply at this stage. An example of an implementation plan from this field is the model devised by Wight in 1981. Wight's (1981) seven step plan of PMS has been advocated and referred many times as the most popular route to take in MRP II introduction. It is comprised of:

1. First cut education in the system
2. Justification for the adoption of the system
3. The selection and appointment of a project leader
4. Seeking and use of professional guidance
5. The finalisation of a project plan (with accountability)
6. Final education of system users
7. Regular, constant management review of the system

1. First cut education in the system

First cut education was carried out in a very rushed fashion in all but three of the companies (Plasco B, Printco C, and Plasco C). The net result of this was that in the remaining companies, a system was introduced into the operations of which only a handful of people had an initial knowledge of what was being introduced. This initial knowledge was supplied by either the system vendors or personnel with a prior knowledge of systems, as in the case of Plasco C. Printco C had gone through exhaustive training and explanations of the systems capabilities prior to the system adoption, and thus were more comfortable with the system when it came to be introduced. The research showed that in companies that did not have prior general education of their system before implementation, their learning process, faith and expectations in the system were at a very low level and consequently held up full system implementation.

2. Justification for the adoption of the system

Justification for the introduction of the system was an interesting point for comparison between the various categories. Companies in category one could not justify the expenditure or "hassle" for the introduction of a new system into their existing operations. In category one there was a "if it isn't broken don't fix it" attitude towards the need for a more formal method of operations. In the case of the majority of category two companies, not all of the management could fully justify the need or use of a new system, and it was at this stage that a certain amount of covert resentment to the new systems introduction occurred. It became clear that without a prior justification for the system from each of the key managers, commitment to the system's success could not be fully generated and utilised. What tended to be the norm in category two situations was that their was a strong justification for the system from the junior to middle management who could see the potential advantages to the operation of a new

system due to the drawbacks of the old/existing system. It was at the senior management level that generally failed to see the immediate justification for a replacement system. The positive extreme of this was in the case of the category three companies in which all of the management collectively saw and found justification for the introduction of a system.

3. The selection and appointment of a project leader

On the issue of the appointment or the emergence of a project leader (a person concerned with optimising and co-ordinating resources - Management Dictionary, 1992), again there were some interesting comparisons between the categories present. In category two companies, the champion of the system generally emerged from the frustrated ranks of middle management. Following the emergence of this person, senior and peer management unofficially loaded this person with the sole responsibility of the entire system introduction and in some cases the entire computer system in the company (Mouldco C, Foodco B, Printco A, Fabco B, Plasco B). This person generally had no formal experience of computers nor of project implementation, only a desire to better the system of method of operation currently in use. The ramifications of this was that when the project got too much or the emergent project leader left, the project was dead in the water without formalised procedures in place. Only one category two company had formally selected and approved a project manager to steer the introduction of the system (Foodco B). In the case of category three companies, two situations existed - either an officially appointed project leader within the company (e.g. Fabco C, Plasco C), or the existence of an MIS department (Printco B). This conferred on the system's introduction a formality and accountability that enabled structured and formal methods of "tweaking" the system implementation. It also allowed a longer horizon to be given to working projects as there was a dedicated person or resource; the result of this was that viable projects dealing with the system were not now shelved due to

the project manager having to give his attention to other non-system related functions.

4. Seeking and use of professional guidance

In all but one of the companies no external consultants or professionals were used. Indeed, in the company that did use "professional guidance", Plasco B, interestingly was the closest company to the boundary between categories two and three. There was a common attitude towards the use of consultants other than the vendors supplying the system. They were viewed as a surplus requirement to the implementation process and as an unnecessary expense.

5. The finalisation of a project plan (with accountability)

When it came to project planning, this area was explored under two different guises, that of the company's quality programme and it's PMS implementation. There was a definite link found between the two in that no company that had *not* achieved a formal quality award was not to be found operating a successful PMS. In this case it was due to the ability to formulate and instigate a project plan. Category one companies had no experience of project planning and based on this and theoretical evidence it is unlikely that they would therefore succeed with PMS implementation with no skills in this area. Category two companies that had not had experience of planning for quality awards (remembering that it was found that all companies operating formal PMS had achieved some formal level of quality control) had not been able to plan for PMS in their companies. (Mouldco B) Companies such as (Mouldco C, Foodco B, Plasco B) had experience of achieving quality standards and were progressing in a structured fashion toward their goal of PMS implementation. To this end they had set target deadlines, outsourced information, and to a limited degree delegated some planning functions (Plasco B, Foodco B). Category three companies had all implemented their systems having utilised project planning tools and

concepts. It should be noted that in these cases while target deadlines were set and striven to be achieved, they were not set in stone and if there was a need to extend them as the need arose, they were. This occurred in areas such as user education (Printco B), software debugging (Plasco C), and hardware installation (Foodco C). The ability to extend deadlines had the effect of allowing the company to persevere with the systems introduction and not deem it a failure after teething problems, as was the case in (Printco A, Fabco B).

6. Final education of system users

User education in category two companies was viewed and handled in several different lights and styles. Some of the companies were very reluctant to use time and resources to educate their operators (Mouldco B, Mouldco C) as they felt it would increase their employment mobility, and thus education on the system was confined to few and limited in quality. Other companies (Fabco B, Plasco A) only educated one two people in the operation of the system creating a vacuum of inoperation of either of the two personnel were unavailable. Only one category two company had a formal, adequate user education policy to ensure user confidence in the system (Plasco B). In the case of category three companies, each of the five had ensured education of their system users to ensure competent system operation. One company (Printco B) to ensure this went to great lengths, including regular ongoing system education by the companies MIS engineer. What made this easier for this company was the fact that it had already a strong education philosophy which included weekly mandatory training courses. In other companies (Plasco C, Foodco C) there were active policies of multiskilling and in keeping with this philosophy, all aspects of the systems operations were understood by the system operators. One of the category three companies (Fabco C) applied the opposite of this philosophy, educating each section in discreet sections only. As the operations director related "it is better that the floor operator is kept in the dark about the

next job until it is released", the implication that job operations and machining would be worked out of order, causing confusion.

7. Regular, constant management review of the system

Regular management review was found to only apply to category three companies as they would by now have a successful system in place that was to be monitored. Regular system review was very evident in both (Plasco C and Printco B) with constant improvement of the system ensured by very close working ties with the system suppliers and the companies project leaders/MIS engineers. In the remaining companies there was currently a re-evaluation of the system and generation of the company and department relevant screen and system output.

To this end, it has been shown that knowingly or otherwise, category three companies succeeded with their systems due to a formal and logical approach to the systems adoption and operation. This doesn't imply that they had followed the specific adoption route as formulated by Wight (1981), but rather that it was not a haphazard, loosely planned introduction. It was exactly this loosely planned that found to have been the method of adoption of the category two's initial systems. Initial is the word to stress here as some of the category two companies were at the time evaluating and attempting to implement their second system. The approach to the implementation of the second systems in (Plasco B, Foodco B and Mouldco C) implied in all cases that important lessons had been learned and that these companies were en route to progress to category three status.

4.7. CLASSIFICATION OF BARRIERS TO EFFECTIVE PMS USAGE

As all the case companies are representative of various industry types, of a common size (SME) and of a single nationality, the barriers and obstacles found may be classified into several areas. The barriers are directly related to the fact that the company is an SME, a company is in a particular sector, i.e. metal fabrication, tool making, printing, food, or plastics injection moulding, or that the company is operating in Ireland and therefore affected by Ireland-specific factors. Table 4.7.1 summarises this classification.

4.7.1. Small Company Barriers

One main barrier in the company's approach to the education of the user is the pervasive fear that the user, when educated at the company's expense, will only become more mobile and leave the company, this was found to be the case with Mouldco A, Mouldco B, Mouldco C, and Plasco C. Plasco C addressed this problem by tending to employ people with certain variables that would inhibit the employees mobility. The management's bad relationships with salesmen may have arisen due to the management having been sold the right solution for the wrong problem in the past, or for personal reasons; but whatever the reason, it may ultimately prevent the company from acquiring a successful system. The organisational structure of the smaller company was found to have an effect on the success of the system - a company which had a solid well represented structure, what was ensured was input from all of the departments in the system selection decision. It also allowed for good communication, management consensus and the easy formation of implementation committees, due to the delegation of tasks.

4.7.2. Sector-Specific Barriers

The toolmaking sector, a MTO environment, in the view of the companies, Mouldco A, Mouldco B, and Mouldco C, felt that their style of operation is not ideally suited to the use of a PMS, and were looking to a more manual style of planning such as considering their operations using CPM project management instead of a PMS. This must be adopted and implemented also, therefore encountering most of the barriers to PMS adoption and implementation. This sector also operates with a short planning and forecasting horizon therefore, in the case of two toolmaking companies, would not plan sufficiently far ahead in order to implement a PMS.

4.7.3. Ireland-Specific Barriers

From six companies across all of the different sectors, was a surprising attitude towards the use of consultants. They had a poor view of consultants and as a consequence were reluctant to use them as a tool to attain a better competitive positioning. This is not the case in America, where extensive use is made of consultants by SMEs. For this reason, it may be considered it a barrier specific to Ireland, and not just small companies. The fact that all the major PMS software companies are located outside Ireland had an impact on some companies in that support and tailoring of the system was not available to them readily. This had a profound effect on the choice and adoption of the subsequent system.

Small Company Barriers	*Sector-Specific Barriers*	*Irish-Context Barriers*
• Poor approach to user education. • Organisational Structure and delegation of responsibility. • Relationships with salesmen. • Fear of increasing employees mobility with education.	• Toolmaking sector's *apparent* unsuitability to PMS. • Low level of use of technology in sector. • Sector operating with a short planning horizon.	• Attitude towards the use of consultants. • Peripherality to PMS software companies. • Level of information of PMS available.

Table 4.7.1 - Classification of Implementational Barriers

4.8. SUCCESSFUL & UNSUCCESSFUL OPERATING ENVIRONMENTS

When the interview data from the fifteen firms was analysed, it became clear to that the success of the system was directly affected by the environment in which the system was to operate in. With this in mind, it is possible to summarise a successful environment and an unsuccessful one. The results of this summary appear in table 4.8.1.

In the case what warrants a successful environment, some production environments may not lend themselves to full PMS implementation. For example in some MTO, Make To Order, (e.g. tool making, job-shop), or ETO, Engineer To Order, environments, the method of scheduling may lend itself better to CPM (Critical Path Method) and other project management techniques, but generally most environments will allow the full implementation of a PMS. A well defined organisational structure with task delegation has been found to circumvent the decision-action failure that Brunsson (1982) spoke of, along with supporting the planning method to the full. Also worth noting has been the effect of the company successfully adopting ISO 9000, in that it had allowed the company to evaluate its existing operation and had given the company the experience of managing a long term project.

On the other hand, several observations may be made of an unsuccessful environment. An interesting point to notice here is the point relating to top management having too much commitment, in some ways a dictatorial attitude. This was observed in one case company where the situation existed of a manager having a very closed, definite idea of what the system was to be for the company, and as a result there was no interaction from the users and no heed taken to the feedback from other departments. The result was a system that

Successful Environment:	*Unsuccessful Environment:*
• The right type of production environment . • The presence of management commitment. • The education commitment of the company. • Establishment strong, open communication links. • Use of formal planning in implementation. • The existence of a technological culture. • A well supported, defined organisational structure. • A "champion" or existing MIS department. • Category two has been passed through. • A strong, planned, formal quality programme.	• Resistance due to fear of job spec. changes. • Lack of total commitment by top management. • Too *much* commitment by top management. • Bad personal relations with systems salesmen. • Implementing solely on intuition; no plan. • Use of poorly developed, piecemeal software. • Bad memories of failed project adoptions. • No information on PMS for management. • Failure to realise that systems must be worked at.

Table 4.8.1 - Effect of Environment on PMS Implementation Success.

took quite a considerable lead-time and many iterations to finally perform as wanted, through the efforts of the MIS department (-the "champions" in this case.). The unusual and unexpected point was the bad relationships with the systems salesmen with the decision maker in the company, which manifested itself to such a degree that the system was scrapped due to this reason in one company, and did not go live in another company - regardless of the worth of the system. On topic of failed project adoptions in the past, while they did not actually prevent the adoption of a new system, they did make the company tread warily in the extreme.

CHAPTER FIVE

DISCUSSION OF SURVEY RESULTS

5.1. INTRODUCTION

The purpose of the fax questionnaire was, as stated previously, a method of augmenting the case study data and seeing how the findings from the case companies held up in the wider field of national industry. This survey actually made two additional contributions to the research project as a whole:

(i) It provided wider descriptive information on the current state of PMS adoption and implementation and related factors in Irish SMEs.

(ii) It provided further insight into the barriers to the adoption and implementation of PMS, thereby complimenting and extending the case data and providing further confirmation of their reliability.

So while the initial purpose of the fax survey was to act a validation tool, it also was to function to allow for the discovery of new information that might hint at further factors that would act a barriers to PMS adoption and implementation.

This section presents the results received for the survey questionnaire that was distributed by fax to 156 companies. The questionnaire (appendix B) covered areas including respondent data, company facts, quality programmes, education levels, computer communication capability, types of production management systems currently in use, and also the barriers hindering their effective implementation and exploitation. Each response was coded in a predetermined manner and entered into a data file. This data was then interpreted using SPSSx©. The data presented here is the result of this process. What this chapter is concerned with is discussing and analysing the data received.

The bulk of the data is presented in tabular format, with each of the three categories being represented by this means of presentation. In order that for each full response the full significance can be presented, each response includes

both the number of companies answering the question, and the number of companies represented as a *percentage of the total 30 company sample* (20% response rate)that completed and returned the survey questionnaire. Table 5.1.1 reiterates the definition of each of the three types of categories

Category	*Definition*
1	Non-user of a formal PMS
2	Ineffective user of a PMS
3	Successful user of a PMS

Table 5.1.1 - Category Definitions

5.2. COMPANY CATEGORISATION:

The categorisations that were used in the survey have been previously outlined and are representive of all companies surveyed. Category two companies yielded the highest response rate, followed by category one, with category three companies being least representitive of all the three categories. Table 5.2.1 illustrates the category representation.

Category	% of Sample	No. of Firms
Non-adopters: 1	26.7	8
Ineffective implementors: 2	56.7	17
Successful implementors: 3	16.7	5
Total	100	30

Table 5.2.1 - Category Representation from Survey

Figure 5.2.1 represents this split, with the largest representation being that of category two.

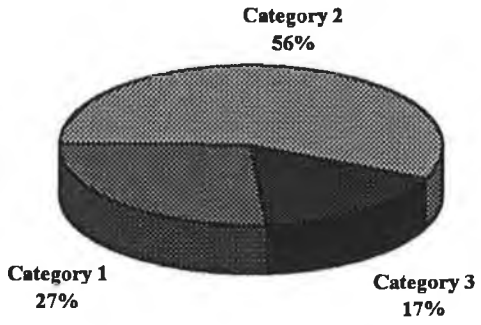


Figure 5.2.1 - Categorisation of Surveyed Companies

Of the five that classified themselves as category three companies, none remarked that they had not passed through a category two phase

5.3. CATEGORY EVOLUTION

The majority of the respondents from the survey were category two companies, with five companies representative of category three. What these five category three companies did was reinforce the finding from the case studies that category two was passed through in each case, and that lessons were learned from it. The chance of passing directly from category one directly to category three due to the data retrieved from these two sources seems a remote one.

This confirms the case data that all of the successful implementors had at one stage or another passed through a phase where they had problems with, or were unhappy with their PMS. This seems to suggest that there is not as yet any prescription for successful implementation that guarantees successful

implementation the first time a modern PMS is adopted. It seems that for many companies spending some time in category two, the ineffective implementation phase, is still an unavoidable valuable learning step to ultimate success.

5.4. RESPONDENT DATA:

The people who responded to the survey tended to be in managerial positions within the company. Table 5.4.1 presents the positions in management that responded to and completed the questionnaire. It is was no suprise that the most common respondent was the company's production manager, the person who was least responsible for the introduction and implementation of the PMS into their company.

Respondent	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
M.D.	25	2	11.8	2	50	2	20.7	6
Fin. Ctrl.			11.8	2			6.9	2
Prod. Mgr.	50	4	58.8	10	25	1	51.7	15
Other	25	2	17.6	3	25	1	20.7	6

Table 5.4.1 - The Position of Respondents in Respondent Companies

Of the seven sectors that were selected to survey: food and meat, plastics, electronics, metal fabrication, timber, printing, and tooling, only six of this seven were represented in the final response. The breakdown of this representation into categories is presented in table 5.4.2.

Sector	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
Food	25	2	5.9	1			10	3
Plastics	25	2	47.1	8	60	3	43.3	13
Electronics	12.5	1	11.8	2			10	3
Metal Fabrication	25	2	11.8	2			13.3	4
Timber			5.9	1	20	1	6.7	2
Printing	12.5	1	17.6	3	20	1	16.7	5
Tooling								

Table 5.4.2 - Sector Representation of Fax Survey

When this is represented graphically, (Figure 5.4.1) it becomes apparent that there is a disproportionally large response from the plastics sector, while no respondents from the tooling sector responded to the survey.

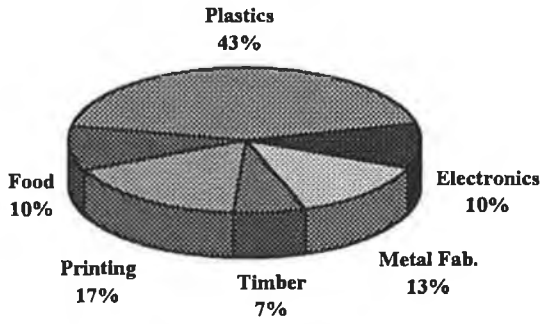


Figure 5.4.1 - Sector Representation in the Survey.

The fact that the largest sector that responded to the questionnaire was the plastics sector must be borne in when considering the data as it may lead to warped representation in comparison to the other sectors. With no tooling

company replying to the survey and only one timber company, again the response of the lone timber company can not be representative of the entire sector.

5.5. COMPANY FACTS

As had been found in the case of the interview data, such variables as size of the company, turnover and leadtimes did not appear to have an impact on whether or not the company acquired and used a system. Nor did whether the company was producing for an export market or supplying just a domestic one. The age of the companies could not be singled out as having an effect either. What may have cancelled out this effect was that while a younger company might have a desire for a modern PMS, the young company's capital outlay may not permit the introduction of the system and thus it's prioritisation as a company requirement may diminish. There was no distinct pattern either to be found between the older companies and their adoption of PMS systems, as some had while others not.

While whether the company was exporter or not did not seem to have an effect, who they supplied did. Companies that were supplying multinationals were influenced by their larger customers, and in some cases pressured into the adoption of new technologies into their operations such as email and EDI. This reinforced what was discovered form the case companies that supplied multinationals (Plasco B, Foodco B, and Fabco C). Sectoral placement of companies affected the uptake of the systems, as had been found from the case studies. One of the findings from the case studies, that of the low use of PMS within the tooling sector could not be tested due to lack of response of this sector to the survey.

5.6. QUALITY PROGRAMMES

In order to determine the levels of quality in the surveyed companies, two questions were asked: that of quality standards awarded and quality methods practised. The standards of quality that each company was questioned on were the domestic and international ISO quality rating, along with the Irish quality mark, Q Mark. Table 5.6.1 presents the standard of quality in all of the firms that responded split in to the three categories.

Quality Award	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
ISO 9001	28.6	2	17.6	3			17	5
ISO 9002	43	3	47	8	60	3	48.3	14
Q-Mark	14.3	1	12	2			10.3	3
No award	14.3	1	23.5	4	40	2	24.	7

Table 5.6.1 - Quality Awards to Surveyed Companies

When this is represented graphically (figure 5.6.1), it becomes apparent that the predominant quality standard in use in all categories is ISO 9002.

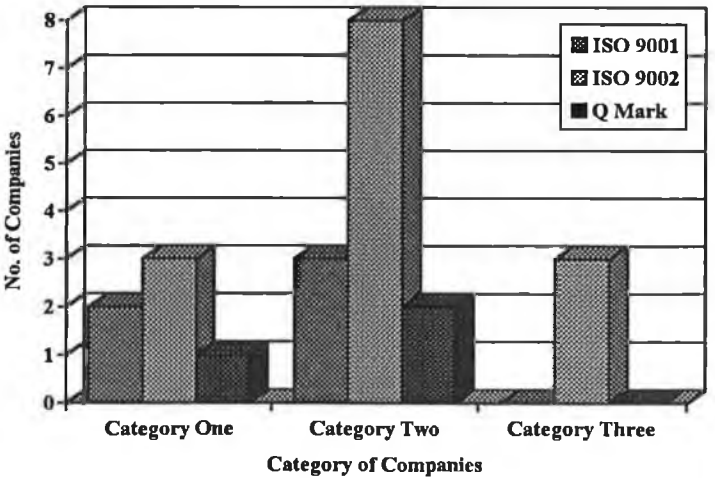


Figure 5.6.1 - Quality Awards to Surveyed Companies

The various practices that the companies had in use included zero defects, the use of quality circles, and the use of total quality control. Table 5.6.2 presents the frequencies of these quality practices.

Quality Practice	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
Zero Defects	28.6	2	11.8	2			13.4	4
Quality Circles	14.3	1	17.6	3			13.8	4
TQC	14.3	1	35.6	6	40	2	31	9
All			5.9	1			3.4	1
None	42.9	3	29.4	5	60	3	37.9	11

Table 5.6.2 - Quality Practices in Use in Companies

The existence of a formal quality system in the company has a strong influence on the introduction and success of the PMS into the companies operations. All of the companies that had operating PMSs had formal quality practices, with the more successful category three companies all certified to ISO 9000 standards. This was also borne true by the case studies which yielded the same finding. It seems that there is a direct correlation to be found between the level and formalisation of quality programmes and the adoption of formal PMSs.

Of those that had a formal quality standard in place, the task of planning to implement the standard was found to be championed by one person or group of people. The person or people who was/were responsible for the introduction of the quality programme in the companies was split and is represented in table 5.6.3. What helped in attaining the level of quality programmes in each of these

companies was this crucial fact - that there was a formal plan devised to aid in this implementation and that there were people in charge of the implementation of the quality plan dedicated to its success.

Quality Champion	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
Managing Dir.	71.4	5	29.4	5	40	2	41.4	12
Prod. Manager			12	2	20	1	10.3	3
Qual Mgr/Mgt team	28.6	2	59	10	40	2	48.3	14

Table 5.6.3 - Champions of the Quality Programmes

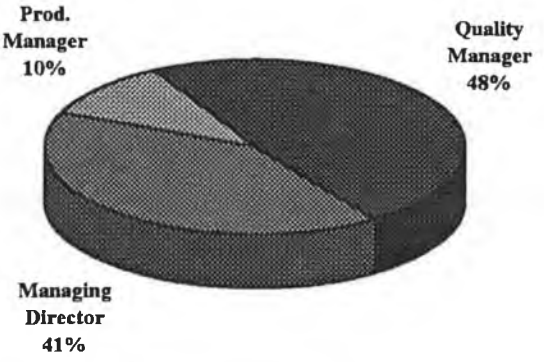


Figure 5.6.2 - Position of Respondents

When categorisation is considered it became clear that in each of the category one companies that had quality programmes, it was the managing director that was in charge of the planning and implementation of the quality programme. While it may be argued that his involvement is due to the possible limited manpower of the company, another possibility is that the managing director implements the programme in an autocratic manner, as was found in the case company studies.

5.7. EMAIL AND EDI CAPABILITIES

Electronic Data Interchange (EDI), and Email, a computer based electronic mail messaging system was in use in 10 of the 30 companies surveyed, and of these 10, 9 claimed its use to have reduced order transaction time for the firm in dealing with it's customers. All of those who were using either EDI or Email would advise their suppliers to adopt and use either of them. Only one category one company had computer communication links, while six category two companies and three category three companies were linked by either EDI or electronic mail to their customers. Table 5.7.1 presents the surveyed level of computer communications usage.

	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
EDI & Email	12.5	1	35.3	6	60	3	33.3	10

Table 5.7.1 - Usage of Computerised Communication

The reasons given by the companies for the adoption of EDI ranged from a major chain store wishing to place orders direct from their stores to the company via an live electronic link. Another cited "customer insistence" as a factor, while another mentioned that it needed EDI to cope with and handle "customer requests". The reasons cited for the adoption of electronic mail, email, included a company policy, or "corporate directive", while another said it was "group policy" to adopt it. Other companies adopted it to improve "customer services support" and to aid the company with "customer requests".

As the results portrayed, very few companies had EDI or email capability, and those that did had so due to either increased customer service or customer demand. The companies that had introduced this form of computerise communication had successful PMS systems in operation. This reinforces the link between customer pressure from larger multinationals on the manufacturer to implement formal methods into their operations. What it also shows is that a PMS becomes an essential precursor to EDI and email implementation, due to the fact that for EDI to be fully exploited there must be the available data in common format behind the system. The fact that one third of the respondents were using computerised communication demonstrates a level of acceptance of computerisation in issuing works orders and dealing with suppliers and customers. One of the factors that could not be gauged was the level of utilisation of this communication medium.

5.8. EDUCATION AND TECHNOLOGY EXPOSURE

Training, as the literature revealed, is necessary for success in a company considering or in the process of adopting technology in to their operations. In order to deduce the levels of technological awareness and managerial education in the survey sample, questions were asked concerning their participation in an d attendance of training courses and qualified educational courses. Tables 5.8.1 and 5.8.2 present the results.

Area of Interest	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
Operations Mgt.	57.1	4	81	12	40	3	68	19
APICS CPIM	14.3	1	29.4	5	50	2	28.6	8

Table 5.8.1 - Participation in Educational Courses

Activity	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
Training Courses	33.3	2	47	8	80	4	50	14
Seminars	33.3	2	17.6	3	20	1	21.4	6
Workshops	16.7	1					3.6	1
All			29.4	5			18	5
None	16.7	1	6	1			7	2

Table 5.8.2 - Attendance of Companies at Seminars and Courses

These results reflect quite a high level of education with nearly half of the companies participating in training courses, and nearly two thirds of the companies management having undergone courses in operations management. Of the 30 companies that responded 17 subscribed to professional journals, while 8 were members of related/associated professional bodies.

5.9. CURRENT USAGE OF PMS TOOLS

Of those with systems, 14 were manual, 5 purely computerised, and 11 of them using a combination of both manual and computerised systems. Table 5.9.1 shows this split across the three categories.

Type of System	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
Manual	87.5	7	35.3	6	20	1	46.7	14
Computerised			23.5	4	20	1	16.7	5
Combination	12.5	1	41	7	60	3	38	11

Table 5.9.1 - Type of Production Managemnt System in Use

The majority of the category two and three companies use systems that are a combination of computerised and manual systems. As was expected from the structure of the company categorisations, seven out of the eight companies in category one use manual systems. However, this categorisation does not reflect the effectiveness and effeciency of any of these types of systems. Figure 5.9.1 illustrtates this split.

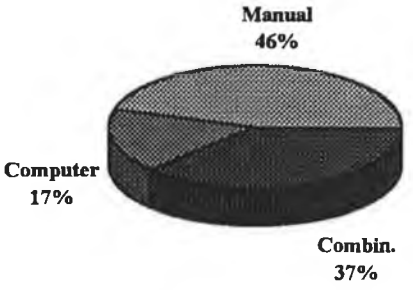


Figure 5.9.1 - Types of Production Management Systems in Use

Of the companies that were using systems, the generation and evolution of the system that was in use, it was a surprising result that there was only one company that had totally replaced it's system (table 5.9.2 and figure 5.9.2). The majority modifying their systems rather than replacing them. This finding is at odds with the some of the case companies that had replaced their systems outright or were in the process of changing their systems (Foodco B, Foodco C, Printco B, Fabco B and Mouldco C).

PMS Evolution	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
Original	37.5	3	19	3	60	3	31	9
Modified Original	62.5	5	75	12	40	2	65.5	19
Replacement			6.3	1			3.4	1

Table 5.9.2 - Generation of Production Management Systems in Use

This tendency to alter the existing systems rather than the acquisition of a new next generation system is an important point, in that companies seem to prefer the old system, albeit improved, rather than attempting to introduce a new system into the operations. This may imply such factors as fear of change, complacency with the systems performance, lack of management desire to introduce a new system, or lack of capital. This has an important implication in deciding whether the focus should shift from implying that companies *should* change to a new system rather than the concentrating on making the existing PMS succeed.

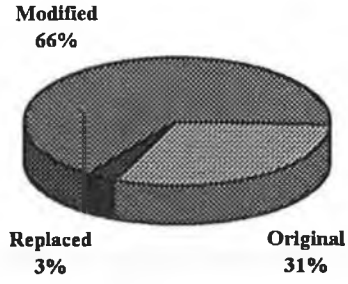


Figure 5.9.2 - Generation of PMS in Use

The companies response to the use of various production management and inventory control tools are presented in tabular format in appendix D and summarised in graphical format in figures 5.9.3 through 5.9.7. The various tools included the use of Computer Aided Design, Computer Aided Manufacturing, Materials Requirements Planning, Distribution Requirements Planning, Capacity Requirements Planning, Production Activity Control, and Manufacturing Resource Planning. They were asked whether any of these techniques were in use or if the company was going to introduce them, when the introduction would take place.

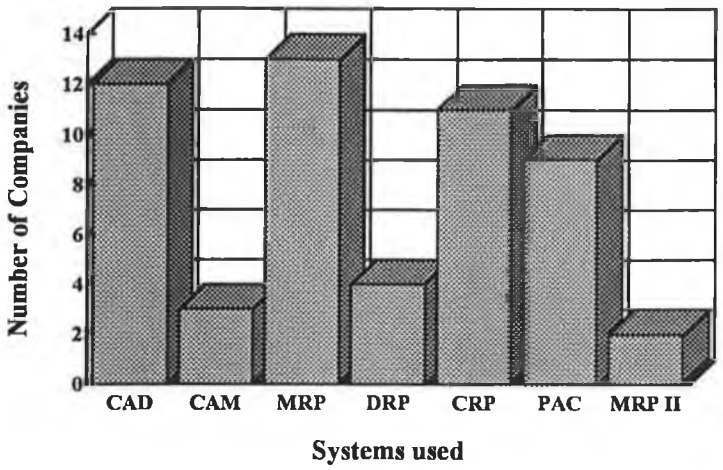


Figure 5.9.3 - Production Tools in Current Use

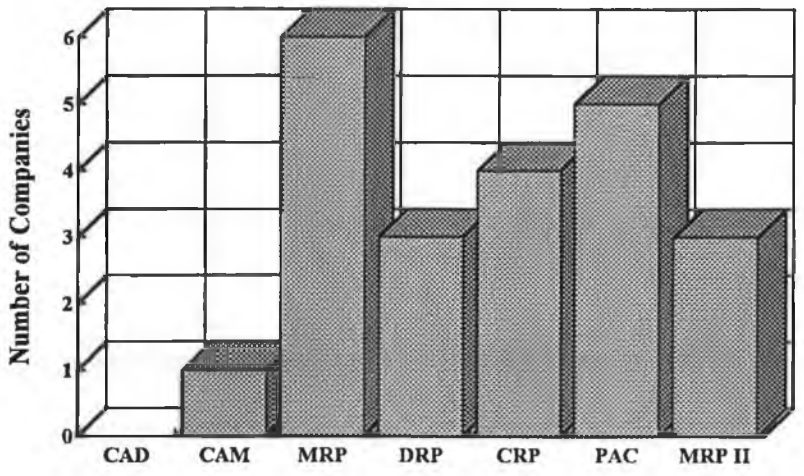


Figure 5.9.4 - Production tools companies adopting within 12 months

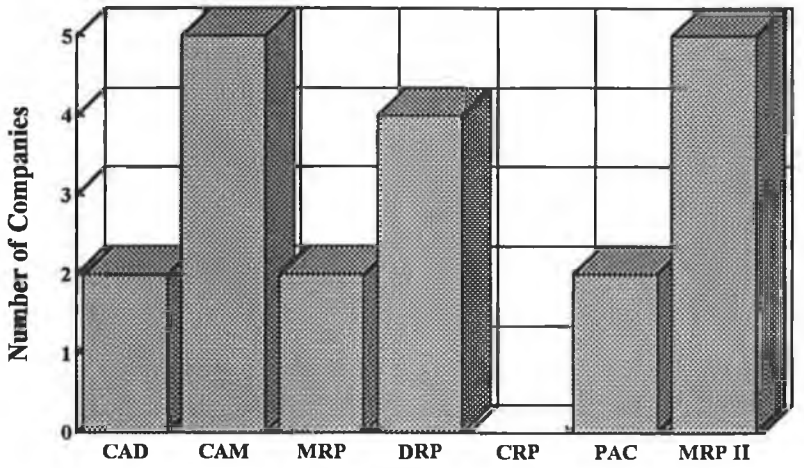


Figure 5.9.5 - Production tools to be adopted within 5 years

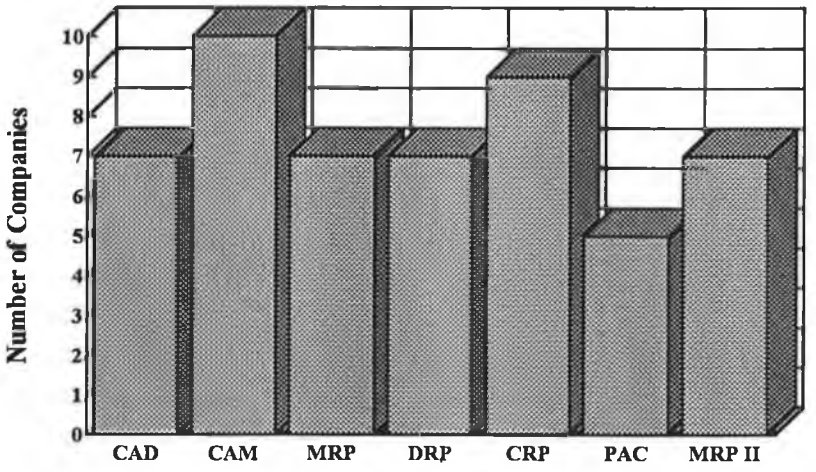


Figure 5.9.7 - Production tools that companies would consider using

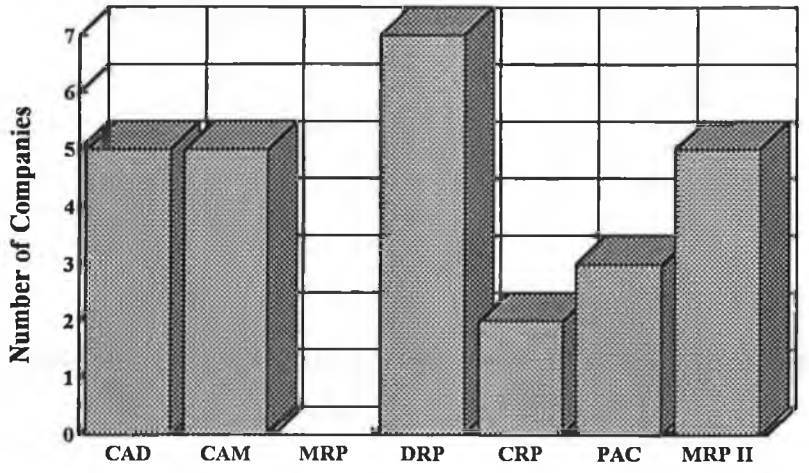


Figure 5.9.7 - Production that would never be used

The response to these questions (this data is presented in detail in appendix D) varied widely without any clear, obvious trend. What it does show is a predominance of MRP currently in use in the survey companies, with CAD almost equally common, indeed no company admitted that they would never use MRP. Interestingly, there is a growing interest in the adoption of CAM technology over the course of the time. What was discovered was that MRP II systems have the lowest uptake, with only two companies using this system of manufacturing planning and control.

5.10. VIEWS ON PMS USAGE

The respondees were questioned on their company's attitude to the value of a production management system being used in general. Table 5.10.1 presents the reply received by category.

Importance	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
Low	37.5	3	18.8	3			20.7	6
Medium	50	4	37.5	6	80	4	48.3	14
High	12.5	1	43.8	7	20	1	31	9

Table 5.10.1 - Attitude Towards Importance of Production Management Systems

The companies were asked to give their opinions on whether they thought that the use of PMS in a manufacturing environment was necessary for efficient production, whether or not their current system could cope with their operations, and then if they could cope and manage their production without their system. The responses to these questions are represented in table 5.10.2

Question	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
PMS necessary for production efficiency	87.5	7	100	17	100	5	96.7	17
System Cope with Operations	62.5	5	58.8	10	100	4	65.5	19
Could you operate without system	50	4	52.9	9	60	3	53.3	16

Table 5.10.2 - Responses to Questions Regarding PMS Usage

While virtually all the survey companies agreed that a production management system is necessary for production efficiency, (only one category one company disagreeing), it is then interesting to note that one in six companies regard it with a low level of importance in their environment, every second company with medium importance, and only one in three with a high level of importance. Due to the documented and now researched data, the plight of the category two company becomes apparent, with two in every five category two companies admitting that their system cannot cope with their operations.

5.11. PMS IMPLEMENTATION IN THE SURVEYED COMPANIES

In this section deals purely with the two categories which endured or are enduring the implementation process, that of category two and three. The companies that had followed their implementation plan without deviation were in the minority (Table 5.11.1). This, however, could be viewed in a positive way as it implies a level of flexibility and a more dynamic approach route than a steadfast rigid one. In the case of category two companies, only under half of the companies had actually devised plans for the implementation of their system. What is surprising about this is that the majority of the category two companies with quality programmes had all formally planned for their introduction as stated earlier.

Planning	Category 2		Category 3		Total	
	%	No.	%	No.	%	No.
Plan devised	47	7	80	4	41	11
Plan followed	37.5	6	75	3	33.3	9
No deviation	13.3	2	50	2	15.4	4

Table 5.11.1 - PMS Implementation Plans

While the planning horizons for the implementation were:

Planning Horizon	Category 2		Category 3		Total	
	%	No.	%	No.	%	No.
Greater than 1 month			25	1	3.7	1
Greater than 6 months	44	7	50	2	33.3	9

Table 5.11.2 - Implementation Planning Horizons

All but one of the more successful category three companies had planned for the introduction of their PMS before attempting its implementation. As these companies, by their own admittance, are all operating successful systems, the fact that they planned for their systems' implementation may be presumed to be a factor contributing to system success. This fact proves what was discussed in the studies documented earlier and the case company profiles showing that planning is a necessary foundation for the successful introduction of the PMS into a company.

What seemed most surprising was the fact that the production manager was the person least involved with the introduction of the PMS into the company, and in the majority of cases it was the managing director and the financial controller who were the most active in the introduction of the system (Table 5.11.3). This was also found to some extent from the case companies. The main drawback to this is that the production aspect of the system may be neglected while the financial aspect would receive more attention. An extension of this would be that the more attention would be paid to the education of the financial staff rather than the production staff, who may even be dealing with a substandard production module in the PMS.

Position	Category 2		Category 3		Total	
	%	No.	%	No.	%	No.
Managing Director	12.5	2	80	4	21.4	6
Production Manager	12.5	2			7	2
Financial Controller	19	3			11	3

Table 5.11.3 - Position of PMS Implementation

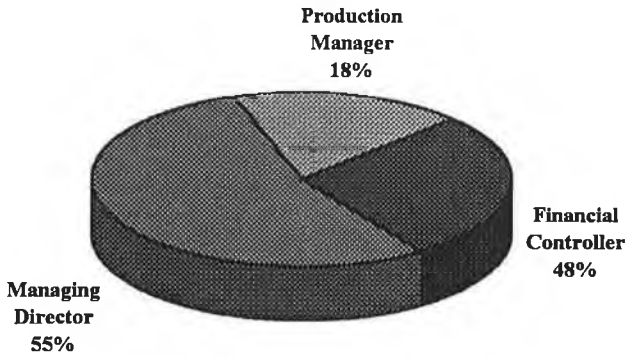
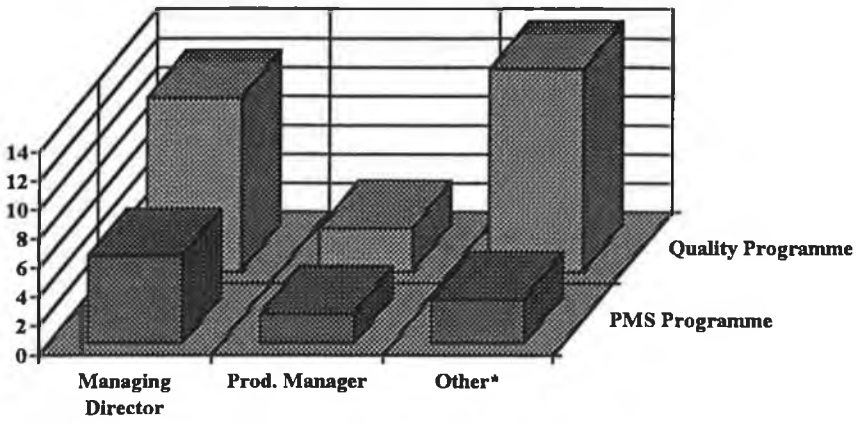


Figure 5.11.1 - Position of PMS Implementor

When the positions of those who implemented the PMS into a company and who implemented the quality programme (figure 5.11.2) an interesting fact becomes apparent. This fact is that in the majority of cases it is the managing director that takes direct responsibility of the PMS introduction, while in the area of quality, it is the norm for a team to be formed to implement the quality programme. When this fact is tied to a comparison of successes of quality practices and PMSs, it could be suggested that the managing director taking charge of the system's implementation is a mistake.



*Other = quality managers, quality teams, and financial controllers

Figure 5.11.2 - Comparison of PMS and Quality Practice Implementors

5.12. EDUCATION OF THE SYSTEM USERS:

Education of the system users was looked after by the company adopting the system in eleven of the companies and by the system vendor in ten of the companies, with only two companies citing a joint operation with them and the vendor in educating the users.

Educators	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
Company	75	4	25	4	80	4	44	11
Supplier			56.3	9	20	1	40	10
Other	25	1	6.3	1			8	2
Firm & Supplier			12.5	2			8	2

Table 5.12.1 - Sources of Systems User Education

The time horizon given by either the system supplier or the company to complete the education of the system varied from over a week to over 4 months. It was not clear whether these educating periods were vendor or company driven, just as it could not be ascertained whether either company driven education programmes or vendor driven education programmes were more effective.

Educating Period	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
>1 week			27	4	25	1	23	5
>3 weeks			6.7	1			4.5	1
>6 weeks			13.3	2	50	2	18	4
>12 weeks	100	3	53.3	8	25	1	54.5	12

Table 5.12.2 - Time scales for System Implementation

The majority of the system users were educated in house in all categories (table 5.12.3) with only five companies using outside courses solely.

Education Site	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
In-house	75	3	65	11	80	4	69	18
Outside courses			23.5	4	20	1	19.2	5
Both			12	2			7.7	2
Other	25	1					3.8	1

Table 5.12.3 - Venue for System User Education

5.13. PROBLEMS WITH THE SYSTEM

Problems arose with all but one of the companies that had implemented systems. As it would have been impractical list all of the possible problems that could have been encountered, the problems were divided into three main areas: personnel, hardware, and software. Table 5.13.1 presents these problems as they occurred for the category two and three companies that had implemented systems.

Type of Problem	Category 2		Category 3		Total	
	%	No.	%	No.	%	No.
Personnel	19	3	40	2	20	5
Software	25	4			16	4
Hardware and software	19	3			12	3
Personnel and software	12.5	2			8	2
All			20	1	4	1

Table 5.13.1 - Types of System Problems Encountered

When these are illustrated graphically, figure 5.13.1, it becomes apparent that the largest problem was that of personnel and their involvement with the system. Personnel is inclusive of management and operators, and may therefore be extended to include user acceptance, lack of management and operator commitment, lack of trust in the system, and other factors discussed in both the review of the literature and the discussion of the case companies.

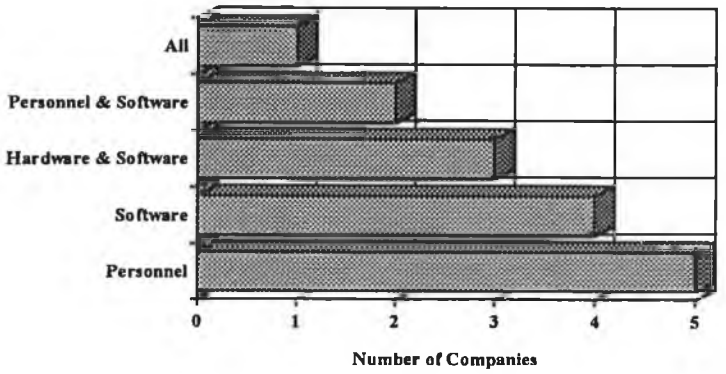


Figure 5.13.1 - Problems Encountered During System Introduction.

Solution to these problems were sought mainly from the system supplier. In only one of the cases did the company and the system supplier solve the problem jointly (Table 5.13.2).

Problem Solver	Category 2		Category 3		Total	
	%	No.	%	No.	%	No.
System Supplier	60	9	40	2	46	11
Other	6.7	1	20	1	8.3	2
Both	6.7	1			4.2	1

Table 5.13.2 - Solver of System Problems

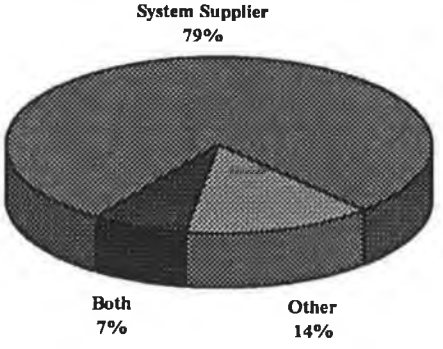


Figure 5.13.2 - Sources of Solutions to System Problems

The large proportion of problems that were dealt with by the supplier alone when twinned with the amount of systems that are operating ineffectively leads to the possibility that if the company were to get involved more in the problem solving stage, then the system's problems may be addressed more effectively.

5.14. SOURCES OF INFORMATION

When queried as to the source of information received concerning production management systems, the respondents replied with results that are presented in table 5.14.1 and figure 5.14.1. The majority of the information came from personal contacts and new personnel entering the company bringing information in with them. The next most popular source of information was from parent company of the Irish operations questioned, with the third most common source being technical consultants.

Source	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
Tech. Consultants			31.3	5			19.2	5
Parent Company	60	3	12.5	2	20	1	23.1	6
Suppliers			18.8	3	20	1	15.4	4
Customers					20	1	3.8	1
Salesmen					20	1	3.8	1
Trade Exhibitions			12.5	2			7.7	2
Personal Contacts & New Personnel	40	2	25	4	20	1	26.9	7

Table 5.14.1 - Sources of Information on Production Management Systems

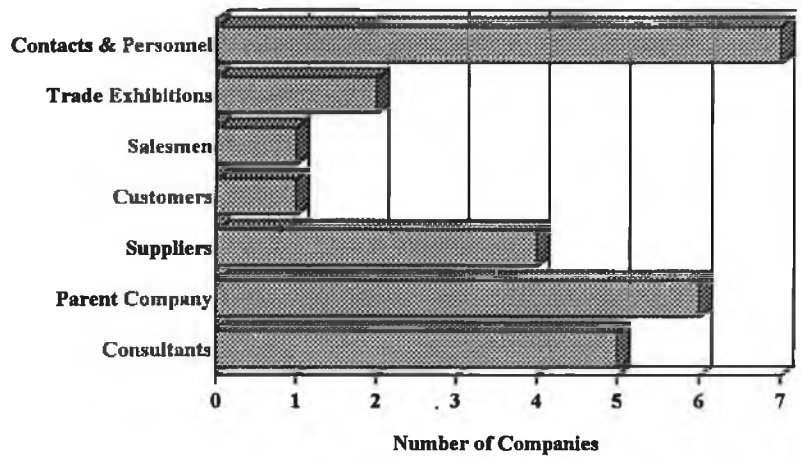


Figure 5.14.1 - Sources of Information on Production Management Systems

What figure 5.14.1 illustrates is a lack of information available form formal channels, i.e. salesmen and trade exhibitions, and with system information coming from more informal channels as personal contacts, new personnel and within the parent company. On the issue of the parent company, the questionnaire did not endeavour to find how the parent company may have sourced it's information.

Only 25% of the total survey sample admitted to finding independent, non-biased information sources for advice on the selection of a production management system. 20% of category one companies, 27% of category two companies, and 25% of category three companies.

5.15. BARRIERS TO THE USE PMS IN CATEGORY ONE COMPANIES

The barriers that were experienced by the category one companies in attempting to adopt production management systems into their operations were:

Barrier	%	No.
Top management not convinced of need	13.3	4
Middle management not convinced of need	10.3	3
Too much capital involved	10.3	3
Implementation horizon too long	7	2
Fear of job losses	3.4	1
Fear of job changes	3.4	1
Lack of faith in computers	7	2
Selection of systems too great	3.4	1
No need to change from present methods	18	5
System not considered strategically important	14	4
Other	7	2

Table 5.15.1 - Barriers to PMS Introduction in Category One Companies

What appeared from the data was a reluctance to change from the present method of operations to a new system. This could be attributed to two reasons, the first being that the often small category one company simply does not want or feel the need to introduce a new PMS into the company's operations. This would then explain to a degree the absence of commitment from senior and middle management to introduce the system, as suggested by the data.

Also the fact that they did not consider the use of a system within their company as strategically important. The second reason would be applicable to the

category one company that would feel the need for more control and all the benefits of a PMS, but would feel that the risk in purchasing and changing could not justify the introduction of the system. This is borne out by the large response to factors such as capital outlay required for the system and the long implementation period required for system success.

5.16. BARRIERS TO THE USE OF PMS IN CAT. 2 & 3 COMPANIES

From the selection of barriers provided on the survey sheet, the barriers experienced by Category 2 and 3 companies were:

Barrier	Category 2 & 3	
	%	No.
Not enough information on system	29.6	8
Poor system documentation	29.6	8
Poor system support from software company	30	7
Floor operators not convinced of need	33.3	9
Bad relationships with system salesmen		
Users not sufficiently educated on system	52	14
Company misunderstands it's own needs	26	7
Company misunderstands departments needs	33.3	9
Lack of understanding of computers	33.3	9
Company never effectively plans projects	31	8
Company not trusting of the system	33.3	9
Previous system still in use with new system	23	6
Low knowledge of production management	33.3	9
Other	13.6	3

Table 5.16.1 - Barriers Encountered by Category Two and Three Companies to the Effective Usage of their PMS

The main barrier was the lack of sufficient education of users of the systems' operation. This ties in very closely with the predominant complaint that there is inadequate documentation regarding the system and not enough information on the system itself. The point regarding the system's documentation concurs with the documented literature and been found to have an serious impact on the long term success of a system. It is worth noting that this point was recognised by one of the category three companies (Plasco C) and as such forbade any personal in-house development system software, such as databases, because adequate documentation could not be produced that could support the software if the programmer were to leave. Data from the survey demonstrated that education does not just end with knowledge of the system, but extends further to both the broader element of a rudimentary foundation of knowledge of production management, and the lack of understanding of computers and their abilities and uses within the company.

What also surfaced from the data was a pervasive problem of having confidence in the system and it's output. This was borne out by a large response to the respondents not having trust in the PMS and its use in the company coupled to some degree with a lack of understanding of computers. This failing could be explained by the worrying problem of insufficient education of the users on the system, it's functions and it's capabilities, which once bridged could serve to allay most of these reservations of the system's use. There could also be a reverse side to this problem - in that system confidence could be the horse before the cart, in other words that education of the system user could be stymied by the mistrust of the system. This has been found to be true in the case of the senior management in the company who would be the chief instigators of the user education.

Communication within the company, as in the case of case companies, was found to be prevalent in two guises: that of floor operators within the company not being convinced of the need for the introduction of the system and it's subsequent use, and that of the company's hierarchy misunderstanding the various individual departmental needs. The failure to communicate and inform, with any type of new technology in the workplace, has been stressed time and time again, and as such is a necessary phase in the success of the PMS in any environment.

Detailed data regarding priority of the barriers and their ranked values as the responds saw them appear in appendix D.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER RESEARCH

CONCLUSIONS

The section concludes the work on the topic of the introduction of production management systems into Irish SMEs. This work began by reviewing the literature in the technical area of production management systems. Having found that this area of literature was limiting in its approach to solving the problem of the adoption and implementation of production management systems into organisations, a wider view was taken to encompass the areas of the management of change and organisational psychology dealing with the introduction of new technologies. From looking to this literature a conceptual framework emerged that addressed the problem of adoption and implementation in a new light which allowed consideration of other factors that previously had been overlooked or consigned to other disciplines.

Following this review of literature, the method by which the research was carried out was presented. The method chosen was chosen specifically for the type of information needed and the process by which to extract it. The initial research gathering tool, that of the semi-structuring of multiple case company, successfully gathered the data required to allow for constructive analysis. Following the analysis of is company data, the research path was extended to validity these findings with the possibility of discovering additional information. The research tool used in this case was a survey questionnaire distributed by fax. What resulted for this was a prompt response of 20% adding to the main research data.

The data of most importance, that of the multiple case companies, was then analysed and discussed under the main themes that had emerged from the review of the literature. From this analysis and the information received from the fax survey, conclusions may be drawn that both serve to explain why the adoption and

implementation of PMS in Irish SME is disappointing and how some companies have succeeded. Finally some recommendations will be made for further research in this area that will deepen the understanding and address the recurrent problems in existence.

One of the most striking and common finding was that production departments should be involved earlier in the system selection and implementation, rather than the financial demands of the organisation shouting the loudest first. This resulted in accounts strong-production weak system scenario, serving not to address the original purpose for which it was intended. A promising finding was that where there was a formal quality programme, there was a PMS beginning or operating on a secure foundation. This can be attributed to the rigorous planning needed to introduce a quality standard and thus having planned properly, the system had a chance of success. Organisational structure did have an effect, but only mainly with category one and some category two companies. These companies tended to be too autocratic in their power structures, with total decision centralisation coming from the manager/owner/founder. This resulted in either the system introduction blockage or a weak/incorrect system decision with no internal consultation. Education of the system users proved to be of importance, with the more successful companies having undergone formal training procedures with the system suppliers. The average standard of education of the management also proved to be of importance, a the younger, more educated management quicker to consider and embrace new technologies and computerisation quicker.

To this end, it has been shown that knowingly or otherwise, category three companies succeeded with their systems due to a formal and logical approach to the systems adoption and operation. This doesn't imply that they had followed the specific adoption route as formulated by Wight (1981), but rather that it was not a haphazard, loosely planned introduction. It was exactly this loosely planned that found to have

been the method of adoption of the category two's initial systems. Initial is the word to stress here as some of the category two companies were at the time evaluating and attempting to implement their second system. The approach to the implementation of the second systems in Plasco B, Foodco B and Fabco C implied in all cases that important lessons had been learned and that these companies were en route to progress to category three status.

Some recommendations may be made to help category one and category two companies in their approach to the adoption and implementation of modern PMS into their operations:

1. The targeting of information on PMS to not only managing directors but also to production managers and materials managers. Also training courses to extend to the company's operators.
2. The encouragement of companies who feel they are in a "non-implementation situation", due to their operation type to become aware of companies in a similar environment who have now an established PMS, or engaged project management/CPM practices in order to convince the company that they can adopt a management system.
3. To encourage small companies to look beyond simply introducing the system, but to actually take the opportunity to evaluate their entire company structure and adapt it accordingly in order to facilitate the adoption of PMS. This will have added benefits in other areas also, for instance it will open up communication channels and promote operator thinking and participation, leading ultimately to increased confidence in the company, and smoother adoption of other technologies.
4. To encourage more companies to carry out an analysis of the costs and benefits of a system before embarking on the adoption route, and not to take the avenue of "picking it up as we go along", which will almost certainly lead to scrappy

implementation and dissatisfaction. The education of small companies on the use of project management would also be very beneficial. Also stress the ROI, Return On Investment, of the system.

5. The need to stress that it may not work first time. We found that some companies have expected the system to be working within a month or two. The result when it does not, has led to negative thinking, scrapping of the system and a closed mind towards the ultimate success of future implementations, all resulting in an overall step backwards in the process.
6. Encourage the companies to totally evaluate their existing operations process from start to finish in order to highlight the areas in need of control. This may prove to be essential as a company may decide to implement a system then to discover that their existing mode of operation was without the necessary part numbers and they may then refuse to change or alter their existing operation to facilitate the system.

While these recommendations will not ensure the success of the adoption and implmentaiton of a PMS, they do serve ot highlight some posiitve directions taht may be taken which were learnt first hand from companies that had passed through the process.

RECOMMENDATIONS FOR FURTHER STUDY

During the course of this research, it was found that the amount of work carried out in this area within the Irish context is limited, and as the time and resources for this project allowed only exploration of certain criteria, some recommendations may be may for further research in this area that will serve to cast more light on the issue of PMS adoption and implementation.

1. The issue of companies evaluating their current state and therefore their requirements needs further study. When this issue is accurately addressed, it will serve to minimise the time of exposure to a category two state.
2. Conducting a full nation-wide survey as the main research tool in a similar environment in an effort build a strong bank of data for cross tabulation of many minor impinging factors.
3. Monitor the full implementation process of a real-time PMS adoption in to a category one company. This information can then serve to act as a comparison against the existing literature. This could also be carried out for a category two company progressing to a category three state.

APPENDIX A

INTERVIEW GUIDE

Interview Guide

Interviewing guide for semi-structured interviews of all companies.
(used in conjunction with Dictaphone and annotations.)

Administered by Daragh Killian, Researcher, DCUBS.

SECTION ONE: COMPANY PROFILE

1. History of Company:

1.1 How long is the company in existence?

1.2 Has the company always been independent?

1.3 In what stage of development was the most dramatic growth?

1.4 What was the causal effect that prompted expansion?

1.5 By what factor has labour, product range, machinery, floor size and BOM increased?

2. Company Facts:

2.1 What products do you manufacture?

2.2 How many components do you hold in stock?

2.3 In a typical product, approx. how large is your BOM?

2.4 What are your lead times for your various products?

2.5 What are your supplier lead times?

2.6 What is your product import/export ratio?

2.7 Are all your customers manufacturers?

2.8 Do you have ISO 9000/1/2? - For how long?

2.9 Are you considering WCM?

2.10 How many do you currently employ - mgt. vs. operators?

2.11 What is your turnover, profit margin?

2.12 What is your % of profits reinvested in R&D?

2.13 How would you define your operation type (ATO..etc)?

2.14 What is your current inventory turn?

3. Organisational Structure:

3.1 Help me create an administrative organisation chart of your company's management structure.

3.2 Do you have a specialised Systems Manager?

3.3 Is the decision-making process heavily bureaucratic?

3.4 Does clearly defined delegation of authority exist?

3.5 Are there clearly defined procedures in operation?

3.6 Is operator input considered in decision making?

3.7 To what degree are responsibilities delegated?

4. Company Strategy:

4.1 How would you view your company's strategy?

4.2 What are your company's short-term priorities?

4.3 Do your long-term goals reflect short-term ones?

4.4 Does your company have a formal business plan?

SECTION TWO: CURRENT LEVEL OF I.T.

5. Present System:

5.1 Do you currently use computers?

5.2 Tell me about your hardware: network, PC, micro..?

5.3 What non-PMS software do you use: WP, spreadsheet, CAD..?

5.4 How much has your company invested in IT?

5.5 Is your Systems Manager responsible for the entire system?

5.6 How long have you been using this system?

5.7 Have you kept your system updated and under review?

6. Non-PMS System Users:

6.1 What % of the staff interact often with computers?

6.2 What is the users level of computer literacy?

6.3 How were the operators educated in computers?

6.4 Do you warrant time off for training courses?

6.5 Would/do you pay for them?

6.6 What level of confidence exists in computers here?

6.7 How long did it take to establish confidence?

6.8 How involved were the users in the planning process?

7. The Non-PMS System:

7.1 What influenced your initial decision to purchase?

7.2 Who advised you on what hard and software to purchase?

7.3 Did your company produce a plan before the decision?

7.4 What period of time did this plan cover; what goals?

7.5 To what degree did the profit made by your company affect the amount spent on your system?

SECTION THREE: EDUCATION

8. Management Level:

8.1 From what background have your managers come from?

8.2 Have any of your managers attended courses; e.g. CPIM?

8.3 Do any of your managers hold an MBA?

8.4 Are educational courses encouraged for senior staff?

8.5 Does your company allow time off for these courses?

8.6 Is there a formal financial arrangement for courses?

8.7 Does the company regularly attend seminars?

9. Operator Level:

9.1 What is the educational standard of the workforce?

9.2 Do operators attend educational courses?

9.3 Is in-service education in operation in the company?

9.4 Is there any firm-specific training in your company?

9.5 Does the company allow operators time off for courses?

9.6 Does the company finance any of these courses?

9.7 Is education encouraged at operator level?

9.8 When new equipment is purchased, how is the operator educated?

10. Education of the System Users:

10.1 Was education of all operators considered?

10.2 Was it included in the system deal?

10.3 If so, what was the level on offer to the operators?

10.4 How was the education of the Users/Management handled?

10.5 Was a formal plan of education instigated?- by whom?

10.6 Prior to implementation, how would you have rated the level of knowledge required for the system?

10.7 With the system installed, how would you now rate that level?

10.8 By what methods were the users educated? - was it different from the education of the managers?

10.9 Were the users receptive to the education process?

10.10 Were your education methods effective and successful?

10.11 What time frame was allowed for education?

10.12 Does the pyramid principle reflect the system education in your firm?

10.13 Would the users be more open to further education now than before? (probe: more innovation)

10.14 Are you in regular contact with your counterparts in other companies, do you meet to discuss new ideas etc.?

SECTION FOUR: SYSTEM IMPLEMENTATION

11. Preparing for the System:

11.1 Did you evaluate/assess your existing mfg. system?

11.2 Did the result of this prompt the need for the system?

11.3 Was this evaluation in-house or consultancy based?

11.4 Was employee feedback an issue in the assessment?

11.5 What were the other factors in the decision to adopt?
-company innovation...
-market pressure...
-customer pressure...

11.6 Was the workforce aware of the need for the system?

12. System Selection:

12.1 Was there a formal plan of attack devised for selection?

12.2 Where did you get the information on various systems?

12.3 Were consultants used in providing the information?

12.4 Was any information brought in by new personnel?

12.5 How extensively were the other systems reviewed?

12.6 How was the selected system evaluated & decided upon?

12.7 Was only one particular aspect, e.g. MRP, targeted first, or was the system taken as a whole?

12.8 Was a Cost-Benefit Study carried out? With what results?

12.9 What the predominant factors influencing your choice?

13. System Implementation:

13.1 Was there a steering committee formed to implement the system?

13.2 Was a systems project team formally formed?

13.3 Was a formal, timed implementation plan created?

13.4 How was it scheduled? - CPM, PERT, etc.

13.5 Did this implementation plan break into sub-tasks?

13.6 Talk me through the implementation steps.

13.7 Were responsibilities formally delegated to the team?

13.8 Whose responsibility was education of the operators?

13.9 Was the need to trust the system fully explained?

13.10 Was there a target time set for dispensing with the previous system?

13.11 Was resistance met at any stage?

13.12 Which stage in particular, and by whom?

13.13 Was all the workforce informed of the installation?

13.14 To what degree, and at what stage?

13.15 How much service did the supplier offer to install?

13.16 Did the supplier fall-short/meet/exceed this goal?

13.17 What was your first, biggest installation problem?

13.18 How was it tackled/solved, and by whom?

13.19 Did this problem alter your implementation plan or time target?

13.20 What subsequent problems have you encountered since?

13.21 In hindsight did implementation proceed as planned?

13.22 Did you think there was/is a culture problem in the adoption of a computerised PMS?

SECTION FIVE: PRODUCTION MANAGEMENT SYSTEM

---------- *THIS SECTION FOR CATEGORY ONE COMPANIES ONLY* ----------

14. Outline of Current System:

14.1 Is any aspect of your PMS computerised?

14.2 If so, which part? e.g. database(BOM); MRP...

14.3 Do you use a computer spreadsheet for any aspect of it?

14.4 Is it purely paper files and planning charts?

14.5 What was the cost of the system?

14.6 How long is the system in use?

14.7 How many people use the system? (%)

14.8 How many have control of the system?

14.9 Is it your first system, or a deviation of your first?
-Is it a total replacement, new in every respect?

14.10 Does your system handle all your needs?

14.11 Is your system under constant review & improvement?

14.12 Is the system rigorously or casually adhered to?

14.13 Has your system reduced any slack while in operation?

14.14 Are you happy with your current system?

14.15 Has the need for a new system increased recently?

15. Drawbacks of Current System:

15.1 What area is it particularly weak in?

15.2 Is this weakness holding back efficiency/production?

15.3 Are there weak links between any two areas?

15.4 Is it flexible enough for your manufacturing process?

15.5 Is it difficult to for everyone to use & follow?

15.6 How accurate is the current system? - Integrity

15.7 Does you currently use part, order & job numbers?

16. Current System Utilities:

16.1 Does/how does your system cope with:

Sales and estimates?
Scheduling order releases, purchasing, capacity..?
Stock control and maintenance?
Expediting & de-expediting?

16.2 How does it integrate with:

Finance?
Marketing? (-capacity relationship)
Stores?

17. System Adoption Proposal:

17.1 Are you interested in a computerised system?

17.2 Would you adopt a system because of:
Company innovation
Market pressure
Customer pressure
Frustration with current system

17.3 Would your company accept the long set-up lead time?

17.4 Would pay-back be a high priority consideration?

17.5 Would the company justify the capital outlay?

17.6 Would in-service training rate in the selection?

17.7 What would you expect of a system?

17.8 How committed would you be to the installation of a CPMS?

17.9 If you made a decision to adopt a new system, how would begin the search? (-consultants, other companies...)

17.10 Who would be responsible for system selection?

17.11 Would you have an organised plan-of-attack?

17.12 Do you believe in the benefits resulting from a new system?

17.13 What areas would you like to tackle most?

17.14 Do you see a new system as a threat to jobs, or as an avenue to expansion?

17.15 Are you apprehensive about the affects you think the new system might have on existing operations?

17.16 Would this apprehension be a deterring factor?

SECTION FIVE: PRODUCTION MANAGEMENT SYSTEM

---------- *THIS SECTION FOR CATEGORY TWO & THREE COMPANIES ONLY* ----------

18. Outline of Current System:

18.1 If computerised, is it spreadsheet based?

18.2 What was the cost of the system hard/software?

18.3 Is it a modular software system, or a batch programme?

18.4 How long is the system in use?

18.5 Is your system the same as your parent company?

18.6 Is it your first system, or a deviation of your first?
-Is it a total replacement, new in every respect?

18.7 What generation system is it? - your second, third?

18.8 Was service and upgrading included in the deal?

18.9 Is the dealer and servicer one and the same?

18.10 Is the system user friendly?

18.11 How many use the system? (%)

18.12 How many people have control of the system?

18.13 Are you happy with your current system?

18.14 Is your system clearly, adequately documented?

19. Drawbacks of Current System:

19.1 Can your current system handle all your requirements?

19.2 What area is it particularly weak in?

19.3 Has this weakness held back efficiency/production?

19.4 Are there weak links between any two areas?

19.5 Is it flexible enough for your manufacturing process?

19.6 Was it difficult to educate the operators with it?

20. Current System Utilities:

20.1 Does/how does your system cope with:

Sales and estimates?
Scheduling? (orders, capacity, purchasing, etc.)
Stock control and maintenance?
Expediting & de-expediting?

20.2 How does your system integrate with:

Finance?
Marketing?
CNC & DNC m/c operation recording?

20.3 Does the system provide feedback to all facets of production.?

20.4 Tell me how the system copes with:

-interaction of the various components of PMS? (explain.)
-interfacing with long range planning?

20.5 Is your MRP module Regen. or Net Change?

20.6 Can it cope with multiple simultaneous users?

20.7 How many terminals & where?

21. Coping With The System:

21.1 What was your first, most predominant problem?

21.2 How was this overcome?

21.3 What have been the subsequent problems encountered?

21.4 What approach is being in solving these problems?

21.5 Is the system rigorously or casually adhered to?

21.6 Do you regard your system as final and complete?

21.7 Is your system constantly audited and reviewed?

21.8 Can the system's program be modified? have you?

21.9 Do you find your agent provides adequate service?

21.10 Would you change your system?

21.11 Would you recommend your system?

21.12 Could you operate without your system at this stage?

22. System Effects:

22.1 How much has the system affected:

Lead times?
Capacity?
Delivery?.....etc.

22.2 How has the system affected your inventory turn?

22.3 What effect has the system had on employee numbers?

22.4 Have any job specs. changed as a result of PMS?

22.5 Are the design of jobs influenced now by PMS/

22.6 What effect has the system had on your part, order, and job numbering?

22.7 What has been the effect of the system on you stores?

22.8 Did you have much reorganisation in terms of filing, indexing and historic part numbering?

22.9 How much paper-work is there now?

SECTION SIX: SUMMARY

23. Reaction:

23.1 Do you believe that innovation is necessary for company survival and/or competitiveness?

23.2 Would you approach the system selection/installation differently now?

23.3 What would the major changes be?

23.4 Will/has the use of PMS in your company altered the way you view your present manufacturing process?

23.5 Are you more receptive to change and technology now?

23.6 Is your manufacturing process more flexible now?

23.7 What effect has the PMS had on your:
- Manufacturing lead times?
- Supplier lead times?
- Quality control?
- Stock on hand and capital investment in inventory?
- Employees approach to work?
- Capacity?
- Product design?
- Material sourcing?
- Inter-level harmony?

23.8 Is what you have now what you expected?

23.9 If not, how does it differ?

23.10 Are you surprised/let down by the results?

23.11 Would your supplier not having a PMS have any bearing on your supplier selection now?

23.12 Have there been any organisational change following the implementation of the system, if so - what?

23.13 Do you feel entirely happy with your system?

23.14 Do you believe in the use of PMS in industry?

23.15 Are you totally committed to the FULL use of your PMS system?

23.16 Are your management team and operators?

23.17 If you were to advise a fledgling company of the use of a PMS, what negative reactions would you expect to hear, and how would you convince them that the system COULD work?

APPENDIX B

FACSIMILE SURVEY & COVER LETTER

DUBLIN CITY UNIVERSITY
BUSINESS SCHOOL

Scoil Ghnó Ollscoil Chathair Bhaile Átha Cliath

DUBLIN 9, IRELAND
Telephone:7045000 Facsimile:360830 Telex:30690

To: «Name»
Company: «Company»
Phone: «Telephone»
Fax: «Facsimile»

From: Daragh Killian
Company: Dublin City University Bus. School
Phone: 01 - 704 5680
Fax: 01 - 704 5446

Date: June 1993
Pages inc. this page: 4

Dear Sir,

I am at present completing the final phase of a research project sponsored by AMT Ireland. The project is investigating the barriers to the successful use by Small-Medium Enterprises (SMEs) of Production Management Systems (PMS) - both manual and computerised. An effective PMS, be it manual or computerised, is a tool that enables a company to plan and control its production, helping to reduce unit costs and improve service levels. The ultimate goal of the project is to identify the barriers to the adoption and effective use of Production Management Systems (PMS) in Irish manufacturing industry.

I would be very grateful if you would complete, and return by fax to the number above, the following questionnaire at your earliest convenience. Your response will enable us to identify the barriers and allow AMT Ireland to develop a strategy for overcoming them.

For the purpose of our research, we have categorised all companies into **three** categories:
Category One: Companies with no formal, documented manual or computerised PMS.
Category Two: Companies with a formal PMS, experiencing problems with its operation.
Category Three: Companies with an effectively functioning PMS controlling all operations.

Please contact me if you have any queries about the questionnaire and be assured that all company information will be treated in confidence.

Yours sincerely,

Daragh Killian

AMT Ireland is a Government supported programme: its aim to develop and transfer Advanced Manufacturing Technology to Irish Industry. It is a division of EOLAS, the Irish Science and Technology Agency.

Dean
Professor J.A. Walsh *MSc PhD FCMA*

DUBLIN CITY UNIVERSITY
BUSINESS SCHOOL

Scoil Ghnó Ollscoil Chathair Bhaile Átha Cliath

DUBLIN 9, IRELAND
Telephone:7045000 Facsimile:360830 Telex:30690

To: _____
Company: _____
Phone: _____
Fax: _____

From: Daragh Killian
Phone: 01 - 704 5680
Fax: 01 - 704 5446
No. of pages: 4

Dear Sir/Madam,

Two months ago I forwarded to your company by fax a survey investigating the barriers to the successful use by Small-Medium Enterprises (SMEs) of Production Management Systems (PMS) - both manual and computerised. This survey stage is the final phase of my postgraduate research project, sponsored by AMT Ireland, which is due for completion at the end of September.

To date, I have received several replies to my initial fax, but to complete the survey effectively it is important that I obtain a larger representation of Irish industry. I would therefore request and be most appreciative of your help with this survey. I would be very grateful if you would complete, and return by fax to the number above, the following questionnaire.

The ultimate goal of the project is to identify the barriers to the adoption and effective use of Production Management Systems (PMS) in Irish manufacturing industry. Your response will enable me to identify the barriers and allow AMT Ireland to develop a strategy for overcoming them.

For the purpose of my research, I have categorised all companies into **three** categories:

Category One: Companies with no formal, documented manual or computerised PMS.
Category Two: Companies with a formal PMS, experiencing problems with its operation.
Category Three: Companies with an effectively functioning PMS controlling all operations.

Please contact me at the above number if you have any queries about either the research project or the questionnaire, and be assured that all company information will be treated with the strictest confidence.

AMT Ireland is a Government supported programme; its aim to develop and transfer Advanced Manufacturing Technology to Irish Industry. It is a division of EOLAS, the Irish Science and Technology Agency.

Dean
Professor J.A. Walsh *MSc PhD FCMA*
Telephone : 7045265, 7045170. Facsimile : 7045446

PRODUCTION MANAGEMENT SYSTEMS

*This survey is confidential and your company name will **not** be revealed in the research findings.*

Please mark all answers with a check ✓ in the applicable box. Please try to answer *all* questions.

Outline of Company:

office use

1. Your Name:_____ 2. Position:_____ ❑

3. Company name:_____ 4. Company activity:_____ ❑

5. Address:_____

6. Tel. number: _____ 6. Fax. number:_____

7. Main Product Range: _____

8. Are you: Food ❑ Plastics ❑ Electronics ❑ Metal Fab. ❑ Timber ❑ Printing ❑ Tooling ❑ ❑

9. What year was your company founded? _____ ❑

10. How many do you employ? >10 ❑ >20 ❑ >40 ❑ >70 ❑ >100 ❑ ❑

11. Is your turnover: £0.5-1M ❑ £1-5M ❑ £5-10M ❑ £10-20M ❑? ❑

12. How many Stock Keeping Units/ number of parts do you hold in stock? _____ ❑

13. Your manufacturing lead times: min. _____ max. _____ ❑

14. Your supplier lead times: min. _____ max. _____ ❑

15. What is your Domestic/Export market percentage: (Domestic) _____% / _____% (Export) ❑

16. Number of Suppliers: _____ 17. Number of Customers: _____ ❑

18. Do you supply to multinationals? Yes ❑ No ❑ 19. How many? _____ ❑

Quality and Communications:

20. Do you have a formal quality programme? Yes ❑ No ❑ ❑

21. Who implemented it? M.D. ❑ Prod. Mgr. ❑ Fin. Contrlr. ❑ Other_____❑ ❑

22. Implementation time: <3 mths ❑ 3-6 mths ❑ 0.5-1 year ❑ 1-2 years ❑ ❑

23. Have you been certified with: Q mark ❑ ISO 9001 ❑ ISO 9002 ❑ ❑

24. Do you practice: Zero Defects ❑ Quality Circles ❑ T.Q.C. ❑ None of these ❑ ❑

25. Was a formal plan to implement the quality programme devised? Yes ❑ No ❑ ❑

26. Was this plan adhered to during the implementation process? Yes ❑ No ❑ ❑

27.Do you have Electronic Mail or EDI capability? Yes ❑ No ❑ ❑

28. When did you adopt electronic mail? _____ EDI? _____

29. What prompted you to adopt either? _____

30. Has it reduced order transaction time for you? Yes ❑ No ❑ ❑

31. Would you advise your suppliers to adopt either? Yes ❑ No ❑ ❑

Current State of Production Management Systems (PMS) in the Company:

32. Referring to the cover sheet, is your company: Category 1 ☐ Category 2 ☐ Category 3 ☐ ☐

33. Do you have a formal approach to planning (e.g.: business plan): Yes ☐ No ☐ ☐

Do you use, or intend to use:

	In Use	Next year	In 5 years	Considering	Never	
34. Computer Aided Design	☐	☐	☐	☐	☐	☐
35. Computer Aided Mfging.	☐	☐	☐	☐	☐	☐
36. Mats. Reqts Plning	☐	☐	☐	☐	☐	☐
37. Distrib Reqts Plning	☐	☐	☐	☐	☐	☐
38. Capacity Reqts Plning	☐	☐	☐	☐	☐	☐
39. Prod Actvy Ctrl	☐	☐	☐	☐	☐	☐
40. Mfg Resrce Plning II	☐	☐	☐	☐	☐	☐

41. Is your system for managing production: Computerised ☐ Manual ☐ Both ☐ ☐

42. What is/are the system(s) called? _____

43. Who is/are the system(s) supplier(s)? _____

44. How long have you had your present system? >1 year ☐ >4 years ☐ Other ☐ ____ ☐

45. Can your present system cope efficiently with your operations? Yes ☐ No ☐ ☐

46. Is your system: your original ☐ original with modifications ☐ a replacement ☐ ☐

47. Do you foresee replacing your system ? Yes ☐ No ☐ To what? _____ ☐

48. What level of importance does your company give to a PMS? Low ☐ Medium ☐ High ☐ ☐

49. Can your company operate without your present system. Yes ☐ No ☐ ☐

50. Do you believe that a PMS is a requirement for production efficiency? Yes ☐ No ☐ ☐

51. If you are a Category 3 Company, did you pass through the Category 2 phase? Yes ☐ No ☐ ☐

Production Management System Implementation Plan:

52. Was a plan devised for implementing your PMS? Yes ☐ No ☐ ☐

53. By whom? M.D. ☐ Prod. Mgr. ☐ Fin. Contrlr. ☐ Other ☐ _____ ☐

54 Was the implementation plan followed? Yes ☐ No ☐ ☐

55. Was it followed without deviation from the original plan? Yes ☐ No ☐ ☐

56. What was the planning horizon >1 mth. ☐ >3 mths. ☐ >6 mths. ☐ ☐

57. Were your users educated: In-house ☐ Outside courses ☐ Other ☐ _____ ☐

58. Who trained the system's users: Company ☐ System supplier ☐ Other ☐ _____ ☐

59. Over what time period: >1 week ☐ >3 weeks ☐ >6 weeks ☐ >12 weeks ☐ ☐

60. Did you encounter any problems during your system introduction? Yes ☐ No ☐ ☐

61. What aspect? Personnel ☐ Software ☐ Hardware ☐ Other ☐ _____ ☐

62. Who solved them?: Consultants ☐ System supplier ☐ Other ☐ _____ ☐

63. What have been your sources of information on Production Management Systems (Please rank)?: ☐

Technical Consultants	☐ ____	Salesmen	☐ ____
Parent Company	☐ ____	Industrial Exhibitions/Conferences	☐ ____
Suppliers	☐ ____	Personal Contacts	☐ ____
Customers	☐ ____	New Personnel	☐ ____
Trade Journals	☐ ____	Other _____	☐ ____

64. Did you find *independent* information on PMS? Yes ☐ No ☐ What source? _____ ☐

Education :

65. Have any of your staff been trained in the area of Operations Management? Yes ❑ No ❑ ❑
66. Have any staff taken part in the APICS CPIM programme? Yes ❑ No ❑ ❑
67. Do any of your staff attend company relevant: training courses ❑ seminars ❑ workshops ❑ ❑
68. Does your company receive trade journals or business magazines? Yes ❑ No ❑ ❑
69. Is your company a member of any trade association or professional body? Yes ❑ No ❑ ❑

Barriers to the Adoption and Effective Use of Production Management System:

Ignoring rank & weight columns, and referring to your classification in Question 32, please complete:
Category 1 Companies: indicate which of the barriers have affected the *adoption* of a PMS.
Category 2 Companies: indicate the barriers hindering the *effective use* of your PMS.
Category 3 Companies: try to recall the barriers that hindered the *effective use* of your PMS at first.

	Yes	*No*	*Rank*	*Weight*	
Barriers to PMS Adoption (Cat. 1):					
70. Top management not convinced of need.	❑	❑	____	____	❑
71. Middle management not convinced of need.	❑	❑	____	____	❑
72. Too much capital involved.	❑	❑	____	____	❑
73. Implementation horizon seems too long.	❑	❑	____	____	❑
74. Fear of job losses.	❑	❑	____	____	❑
75. Fear of job changes.	❑	❑	____	____	❑
76. Lack of faith in computers.	❑	❑	____	____	❑
77. Selection of systems too great.	❑	❑	____	____	❑
78. No need to change from present method.	❑	❑	____	____	❑
79. System not considered strategically important.	❑	❑	____	____	❑
80. Other:_____	❑	❑	____	____	❑
Barriers to Effective PMS Use (Cat. 2&3):					
81. Not enough information on the system.	❑	❑	____	____	❑
82. Poor system documentation.	❑	❑	____	____	❑
83. Poor system support from software company.	❑	❑	____	____	❑
84. Floor operators not convinced of need.	❑	❑	____	____	❑
85. Bad relationships with system salesmen.	❑	❑	____	____	❑
86. Users not sufficiently educated on the system.	❑	❑	____	____	❑
87. Company misunderstands it's own needs.	❑	❑	____	____	❑
88. Company misunderstands departments needs.	❑	❑	____	____	❑
89. Lack of understanding of computers.	❑	❑	____	____	❑
90. Company never effectively plans projects.	❑	❑	____	____	❑
91. Company not trusting of the system.	❑	❑	____	____	❑
92. Previous system still used with new system.	❑	❑	____	____	❑
93. Insufficient knowledge of production mgt.	❑	❑	____	____	❑
94. Other:_____	❑	❑	____	____	❑

Returning to the table you completed above, please rank your top SIX barriers, in order of importance. Now, in the weight column, weight the importance of your six problems out of a total of 100 points. i.e. all six weights will total 100 points. Eg.: 35, 25, 15, 13, 8, 4 (= 100 points in total)

Thank you very much for your co-operation, please comment further if you wish.

APPENDIX C

FULL CASE COMPANY PROFILES

1. INTRODUCTION

The companies that are profiled here are representative of the five sectors surveyed: metal fabrication, high volume plastics injection moulding, food, toolmaking, and printing. Each of the twelve companies portrayed here are classified into the three categories established at the planning stages of the survey, that of no formal PMS, problematic PMS and operational PMS. As was explained earlier, in some of the sectors not all three categories were represented, thus only two category one companies and six category two companies listed here. It should be noted that in the majority of cases the information surrendered was taken at face value and is uncorroborated. The bulk of the interviewees were generous with their time and is consequently reflected in the amount of information generated by the reports. On the other hand, in some cases time and availability was a constricting factor, and along with brevity of the interviewee, served to create spartan company profiles. The interviewees consisted of managing directors, operations managers and financial controllers. In three of the cases, the resident systems managers were also available to volunteer information, and while this may have served to contradict some of the information given by the initial interviewee, for the most part it corroborated and expanded the information on the company's system.

2. CATEGORY 1 COMPANIES - NO FORMAL PMS

2.1. Mouldco A - Toolmaking Sector

Company Facts

Mouldco A is a precision engineering/tooling company that has gradually grown over the last thirty years, the only major factor prompting sudden expansion being a large steady supply contract. The labour force reached a maximum of sixty, but is now forty five. Mouldco A manufactures press tools holding approximately 400 components in stock, valued at £90,000 and turned three times a year. The average BOM is twenty items, with the longest manufacturing lead time for a tool being 16 weeks. The manufacturing lead time includes the design and the drafting of the tool for the customer, unless the customer submits detailed engineering drawings. Mouldco A has mainly domestic market, with minor exports to the Northern Ireland. Table C.2.1 summarises Mouldco A's operational facts.

Category	Estb.	Employment	Turnover	Environment	Quality
One	1962	45	N/A	MTO	No standard

Table C.2.1 - Summary of Company Facts

Organisational Structure, Business Planning and Quality Practices

The company does not have the ISO 9000 rating, but the management is considering working towards it, the problem being that "the more it is discussed

the more we are not sure if we are getting closer of further away form realising it, (ISO 9000)." Mouldco A has a board of six working directors, with the general manager having a seat on the board. The general manager manages the workshop manager in charge of tooling and production, the sales and service manager, and the design engineer in change of the draughtsmen and CAD CAM operator. Board meetings concerning the day to day running of the company are regularly held, with very open communication and little bureaucracy. The longest planning horizon in the company is six months, with no fixed business plan or company strategy. This six month planning horizon is guided by the order book, as no order has ever extended beyond this period.

Education

Mouldco A is a member of the Mould Makers Association of Ireland, and all of the directors come from a tooling background. There is no policy of manager of office staff education, although a CAD CAM course given by the CAD system supplier is being considered for one of the draughtsmen. Some of the operators are engaged in the company's apprentice programme in conjunction with FAS, and others are undertaking the City and Guilds qualification in toolmaking. The education of the operators of the CNC machine was regarded as the responsibility of the machine supplier, with the trained operator then assuming the position of instructor in the company.

Current Levels of Information Technology

Mouldco A uses one 386 personal computer for all of it's administrative functions, while a newly acquired 486 is to be dedicated for CAD CAM use. The CAD system, it is hoped, will be in service within one year and will be the responsibility of one draughtsman.

Current Production Management System

The production management system in Mouldco A is a manual one with a computer being manually updated to create and maintain a database. The annual manual stock count is updated on this database yearly, with no account taken for stock-outs, obsolescence, etc. during the calendar year. This flaw is being investigated and the company hopes to reduce this time bucket to six months. Enquiries and estimates are given specific numbers and this is the number that will follow the job to delivery. When an order hits the floor, a toolmaker will be given the singular responsibility for that job from start to completion. The toolmaker then stages all the material for that job and orders whatever components are necessary. Mouldco A finds this system to work quite well, seldom encountering stockouts. Expediting can be enforced if required, but seldom is. The company recognises that it's current system is inadequate and would like to introduce a more formal, structured PMS. However, it feels that such a system would not be feasible to operate in Mouldco A's environment due to:

(a) The predominant style of management is fire fighting, with "no time for fire prevention", this is due to their short, enforced planning horizon and is also the reason that the ISO 9000 programme has not progressed beyond the consideration stage.

(b) The company lacks "good financial management" that would be required to "upset the everyday operation of the company" and absorb the change-over costs.
(c) They believe that their operation is too dynamic and complex to entrust to a computerised system, and that the savings would be negligible.

2.2. Foodco A - Food Sector

Company Facts
Foodco A was established by the current managing director in 1989 and has always remained independent. The most dramatic stage of growth in the company occurred over the last 18 months due to expansion of the market. The products that Foodco A processes a single raw material - bone and form this materials derives all of its marketable products: calcium phosphate and proteins which are ultimately used in soups, beef extract, calcium tablets, phosphates for petfoods. The proteins being processed into one of three forms - paste, liquid and dried powder. Of the company's 15 customers, 7 would be major, with a 90% export market. The raw material suppliers are the local meat factories, with veterinarian supervised daily bone delivers which are stored chilled for a maximum period of 72 hours. Table C.2.2 summarises the company's operational facts.

Category	Estb.	Employment	Turnover	Environment	Quality
One	1989	31	N/A	MTO	No standard

Table C.2.2 - Summary of Company Facts

The operation is classed as "semi continuous, batch"; Foodco A operating 24 hour 7 day shift, with closure once a month for line cleaning. Upon start-up, the lead time through the system is one day, but the customer order leadtimes necessitating 3 weeks notice, including transport. While the company's products "follow a laid out market, responding to market request", there is some R&D carried out on new products. The production process was developed along current practices with some in-house developments

Organisational Structure, Business Planning and Quality Practices
Due to the small nature of the factory, the management structure is relatively flat, with the managing director having the works manager, production manager, laboratory manager, engineering manager, and finance reporting to him. The processing of orders is carried out by the sales manager, managing director, or works manager, new markets being explored by the managing director. There is very little bureaucracy, with reasonable delegation of authority, clear reasonable with decisions made by individuals themselves. There is a clear, but not written and formal strategy. The long term business plan has the goal to maintain and increase production volume, diversifying with

other products. A goal for early 1994 is the ISO 9000 audit, with the company getting procedurised at the moment, with formal documentation ready by October 1993. One of the reasons prompting Foodco A to adopt ISO 9000 was that it sees it as "useful tool for trading" and remarked that "most of our customers are requesting it, an that we envisage in two years time we would have to have it".

Education
The works manager holds a chemical engineer degree, with the laboratory operators chemical technicians graduates and meat science graduates. The company would allow time off for specific educational courses, and currently has "various people in various programmes". The company would attend only very specifically relevant courses, but sends the TechStart laboratory technician to several seminars and workshops.

Current Levels of Information Technology
There are two stand alone computers in use - one in the office for accounts, wages and clerical use, the second on the factory floor in the process control section, purely for process control. Use of computers - accounts and pay accounting clerk. Foodco A has invested over £5K in information technology systems over the past three years. The only people who interface with the PC on the floor are the food engineers, who all have a proficient level of competence as "the usage of it is quite straightforward". If any problems arise during the operation of the system, the engineering section would deal with the problem.

Current Production Management System
The managing of production is based entirely around a "formal hand written system". The planning horizon is 4-6 weeks ahead written down n a document and compliment the information received for the sales department. Both the production and the sales department are "quite happy with it". The company would ultimately adopt a computerised system with more people interfacing with it, but this would not be for at least two years, the company does not regard it as a priority. Foodco A finds that it's current system is in relation to quality control, recording production and production yields.

Product tractability is allowed for due to the quality records with every batch numbered with a code number, including all production comments, shipping dates, and other information. All of Foodco A's customers have had no problems with the company's system. As the company has just one raw material with 8 end products, control of the process is made easy, - "it doesn't consume much time in planning, it would be a problem if it did". As eight co-products are processed from the single initial material, multiple orders from multiple customers are satisfied form the one can be satisfied. The management of Foodco A are quite content with their current system because it can handle the simple process outlined above. If the process and sales were to become more complicated the company would then feel the "probable" need for a system replacement.

3. CATEGORY 2 COMPANIES - PROBLEMATIC PMS

3.1. Fabco B - Metal Fabrication Sector

Company Facts

The Irish operations of an American multinational, Fabco B has been operating in Ireland since 1985. It currently employs sixty five people, forty five operators and twenty managers and office personnel. Last years turnover was £5.5 million, double that of the previous year. It has no expenditure on research and development as it manufactures purely to it's customer's product specifications. Fabco B is predominately MTO, however as one product accounts for 50% of it's production, it tends towards MTS with this product. The full product range is twenty products, but this figure includes one-off and low demand items, so a more realistic figure is six main products. Over five hundred components are held in stock, with an average bill of materials consisting of thirty items. The average manufacturing lead-time in Fabco B is four weeks, with the longest supplier lead-time being four weeks also. All of Fabco B's customers are manufacturers and the company's market is mainly domestic.

Category	Estb.	Employment	Turnover	Environment	Quality
Two	1985	65	£5.5 M	MTO & MTS	ISO 9000

Table C.3.1 - Summary of Company Facts

Organisational Structure, Business Planning and Quality Practices

Fabco B was awarded ISO 9002 in late 1992 and is looking towards World Class Manufacturing principles. It has been quality certified by most of it's major customers, including Digital and Wang. The organisational structure of the company is based on four managers reporting to the managing director. Below these four managers there is a supervisors and quality inspectors level, and then the operator level. The level of bureaucracy in Fabco B has increased due to the introduction of ISO 9000 practices, with an increase in the formalisation and definition of procedures. The formation of a steering committee has served to ensure that operator input is considered in the decision making process where the operations or policy of the company is in involved. The company's strategy mirrors that of the American parent, including the goal of WCM and the introduction of better information technology systems. These goals are included in the company's long term business plan.

Current Levels of Information Technology

Fabco B is presently running a Northstar network for word processing, CAD, PMS, and accountancy (Pegasus) purposes. The original installation of the system was viewed as necessary by the parent company. Approximately £20,000 has been invested in both the hardware and software, with the system

under constant review. 90% of the office staff interact with the system daily and are all computer literate.

Education
At management level, one manager holds a MBA, with two having completed the APICS CPIM programme and a stores manager currently studying for it. The company allows time off for these courses and financial backing if required. Fabco B rarely attends seminars and training workshops. The level of education among the operators varies from intermediate to leaving certificate, with no policy for aiding floor operators on educational courses.

Current Production Management System
The company is currently using a regenerative MRP system called AGEN (AGriculture and ENgineering). AGEN is not used for it's full MRP capability, instead it is used to maintain BOM structuring allow material planners to schedule requirements manually from the fundamental information. This system has been in use for three years and initially cost £1,200. The main system in use is PROMAIN, a modular system developed for the parent company, which includes capacity, order entry, purchasing, inventory, and job costing (which is not used). PROMAIN is to replace AGEN, mainly because it was felt tits flexibility and ease of modification and customisation. The adoption of PROMAIN was not hat not enough effort was put into AGEN's adoption. PROMAIN is favoured over AGEN due to only due to AGEN's failings, but also due to expansion of the company and pressure from the American parent. Customer pressure was not an issue. Fabco B targeted the total installation and operator education of the system to be complete within one year, during which time the main problem was the change over from the manual to the computerised system. To solve this problem the company was forced to extend their implementation horizon and after a period of time the system gained acceptance. Subsequent problems encountered due to this change-over were not blamed on the system and the company now feels comfortable with their system that they could not operate without it.

3.2. Mouldco B - Toolmaking Sector

Company Facts
Mouldco B specialises in the design and manufacture of moulds for use in injection moulding machines, jigs and fixtures. The company also carries out contract machining and injection moulding. The use of CNC machines in the company has increased from one in 1986 to seven at the present, following an investment of over £750K. The reason for this expansion was to keep abreast with the rest of the industry in order to survive. Due to this expansion of technology, the company can now offer a much wider range of tooling techniques to offer customers.

Category	Estb.	Employment	Turnover	Environment	Quality
Two	1978	37	£1.2 M	ETO & MTO	No standard

Table C.3.2 - Summary of Company Facts

Approx. 1,500 components are held in stock as raw materials, with an annual inventory turn of between 12 and 14 weeks, or four times a year. An average mould can range between 60 to 400 items, with manufacturing lead times of between 4 to 20 weeks. Mouldco B exports 10% of its production, with all of it's customers being manufacturers. The ratio of operators and toolmakers to management is 8:1.

Organisational Structure, Business Planning and Quality Practices

Mouldco B is controlled by the owner and founder. Directly under the managing director is the production manager and a financial controller. The toolroom foreman, in charge of five units, and the moulding foreman, in charge of five moulding chargehands, report directly to the production manager. The chief designer is responsible for the CAD/CAM operations and the design team. There is no quality manager or any quality inspectors, quality being the sole responsibility of the individual operators and toolmakers. Decisions and policy making issues are formulated and acted on by a committee, with clear delegation of authority and delegation. There are no written procedures in place, each job being approached differently when received. Just being finalised at present is the company's business plan that spans the next three years, which includes the investment in CNC, ISO 9000 quality approval, and expanding their CAD/CAM capability.

Education

The background of the owner was tool making, with the production manager having his grounding as a quality manager. Both have attended courses on factory management, quality control, and plant supervision. Educational courses for he management are not encouraged as the company feels that they take up too much time and would thus reduce the operating efficiency off the company. The initial requirements for operators used to be group level, this has now been increased to leaving certificate level. The reasoning for this was that the company was investing time, effort and money in the training of the junior apprentices only for these employees to leave the company trained to go to England. In elevating the entrance requirements the company was getting an older apprentice with ties in the area and consequently less likely to leave. The net result for Mouldco B has been a very reluctant attitude towards the education of the employees, although for very committed operators courses such as City and Guilds courses may be considered. When new machines are introduced, the company sends it's most receptive operators on the course, to then return and train the remaining operates. The company generally allows about two months of trail and error for the operators to get au fait with the new technology. In all, Mouldco B estimates that it has spent over £10K training people. Relevant journals are subscribed to and are read down as far as

supervisor level; the company is a member of both the toolmakers association ,and the Mouldmakers Association of Ireland

Current Levels of Information Technology
In use in the company at present is a network running a CAM system (PPS3), a CAD system (AUTOCAD 11), and an accounting facility (PEGASUS). The company has invested over £120K in the system to date, the production manager being responsible for the selection and implementation of the hardware and non-financial software. The system has been in use since 1987 and is regularly updated, the software being supplied by the initial company that Mouldco B dealt with. Seven of the staff interact with the computers, the deal with PEGASUS including operator education. The CAM/CAM users were sent to the U.K. for a week to train, returned to Mouldco B for a month to practice on the system, and then the system suppliers came from the U.K. for a week. Mouldco B paid fully for this training. Confidence was established very quickly in the use of computers and the company feels very happy about their level of usage.

Current Production Management System
At present the company is managing it's production manually. Mouldco B feels it has no need for a system to keep track of material flow on the floor, considering it to be of no great importance at the moment. Routing are planned manually, as is scheduling. There are biweekly meetings with all production supervisors and production staff to update the schedules and decide on order expediting and arising problems. The company has no computer system for stock management, nor for the tooling department, but wishes to introduce a system into the moulding department, concentrating on two areas:

1. Reduce the excessive time manufacturing moulds by tracking the production process more closely with a view to streamlining the identified steps.
2. To have the ability to calculate the number of hours accurately that are worked on each job.

At present, the second need is calculated manually, but the company would favour a software package that would allow for the recording of this information on their system by means of, for example, operators keying in hours worked against job numbers. The production manager wants a computer terminal at each bench, and at the end of each day the operators would be responsible for the recording of the day's production and labour hours. The following day, the production manager can view the previous day's performance.

The current system/mode of operation is well documented with laid down procedures, allowing for the system continuity if key staff are absent. Eight employees interface with the system and require it's output, with two controlling the operation of the system. The existence of a formal system is in firm evidence on the production floor to all production workers, by means of works tickets, build schedules, etc. For this reason, the production manager feels, the system's integrity is maintained. Their system has been in operation

now for eighteen months, having replaced a system that held all the information on one sheet; the present system having separate sheets for individual requirements, i.e. new moulds, existing moulding tool repairs, etc. However the replacement multi-sheet system, also has shortcomings and it is envisaged that it too will be superseded in the near future. When new moulds are being tooled the system is rigorously adhered to, but less so on mould repairs. Accuracy in the system is quite high and what the system has done is to reduce slack time, but it still needs adjustment and refinement. When the company is approached with an order, quotations issued are based on historical data to estimate costings and schedules. The scheduling of order releases and all aspects of purchasing and procurement is controlled by the drawing office. When the order is received, the drawings are completed, materials are sourced, the job number is allocated, and the order is sent out to the floor, complete with routings and job completion dates. The same job number follows the tool around the process and upon completion, is checked off against the order receipt list.

Bottlenecks do occur in the process, mainly at the wire and spark erosion station and, at present, at the CNC work stations. Because of these bottlenecks, the need has arisen to expedite jobs. In expediting a job through the process, the production manager will consult the foremen to see if he can reassign labour throughout the process. Production integrates with finance once a month to ensure jobs are running to schedule and to confirm job cost estimation. The main reason that the company is planning the introduction of a computerised recording system is ongoing company innovation, and would be under pressure to complete implementation within the three year business plan. He feels that if he doesn't get organised on the issue quickly, it will get on top of them. Pay-back of the system would be a high priority and have to justify the initial outlay. It is recognised that in-service training would be imperative for the success of the new system. He would not consider consultancy to aid the selection of the software system as he views consultants as being "too expensive for what you get out of it". There is a committee that has been established to oversee any changes to the production process in the company, on this committee are all of the production supervisors and the production manager. This committee is responsible for system selection. The new system would not be seen as a threat to jobs, nor would anyone be apprehensive about the effect that the new system would have on operations and feels that everyone would be delighted to see it implemented.

3.3. Printco A - Printing Sector

Company Facts

Printco A was founded by the present Managing Director as a silk screen printing house. The company has always been independent, with all capital being raised internally. The main product line at the start being products such as company reports and sales brochures. Printco A began to expand in a gradual manner until 1980 when the company expanded dramatically due to the

growth of the Irish computer industry and it's need for secondary products such as printed computer manuals. The labour force has tripled and floor space expanded six fold. The printing equipment has also been updated with state of the art lithoprinting machines now in use.

Category	Estb.	Employment	Turnover	Environment	Quality
Two	1959	155	£12 M	MTO & MTS	ISO 9000

Table C.3.3 - Summary of Company Facts

The main products offered by the company are computer manuals, with some deviations from this for special customers. Printco A holds 30 different inks in stock, with 15 different weights of paper . An average run would consist of one of these papers with two inks, although up to four inks can be used at once. The average lead-time for one manual is approx. 14 days with typical runs consisting of 2,000 manuals. All of Printco As customers are domestic, although the products are for a world market, with manuals being printed in several different languages.

The arrangement in existence between Printco A and its customers is one whereby the customers purchasing department is responsible for the sourcing and purchasing of the raw materials, and also responsible for the storage of the same. When a job is ordered, Printco A simply calls off from the customers' stores what is required for the particular print run, thus escaping both the expenses of raw material storage, and the headaches of late supplier shipments leading to false order promising and expediting on the print line. Printco A usually delivers to the customer straight off the printing line, although if a large run is printed or if the customer is not ready for its order, the company will store the manuals in its stores until required. In this regard, Printco A has the expense of storing the bulkier higher value goods, and at present is looking into acquiring more storage space because of the tendency of the customer to leave finished stock on hand with Printco A.

Organisational Structure, Business Planning and Quality Practices

Printco A has chosen a flat management structure. The managing director and the financial controller play an active role in the daily running and policy making decisions of the company, instructing the general manager on company operations. The stock and quality areas each merit one manager, while the binding and lithographic printing areas have been split with a separate manager in each area; so too with the area of production control and storage distribution being divided from production planning and scheduling.,. The company has no systems manager as such, instead the task of computer maintenance falls on the production assistant to upgrade and select the systems for use. The decision making in Printco A would be regarded as highly bureaucratic, with a very clear delegation of authority in existence. The longest planning horizon that Printco A can view is twelve months. No formal business plan exists that would cover a longer planning period, and the company would be more inclined to use short

term goals rather than long term plans. The strategy of the company is dictated by and follows that of the computer companies.

Education

The owner/managing director of Printco A has a printing background, the rest of the management team holding no formal qualifications with the exceptions of the two production assistants, who both hold diplomas in printing technology. The company encourages management courses both financially and with time off. The quality control manager regularly attends seminars in related areas, when time allows. The company subscribes to trade journals, and all staff keep abreast of related publications. The average level of education among operators is intermediate certificate standard. The company's apprentices - two binding and one printing, follows the usual conventions of full financial aid and allowing time off to attend classes. Training of the operators on new machinery which the company aquires in carried out by the equipment supplier, generally in-house, although the company may decide to send the operators to a plant where the machine is in operational use. The company does not have a formal plan for operator education courses, adopting the viewpoint that upon completion of the course, the operator may decide to move to a higher position in another company.

Current Levels of Information Technology

Currently in use in Printco A is a networked 160Mb PC with four terminals. Also in use is a recently acquired Apple Mac, which was primarily brought in as an EDI linking facility to a major Irish based American customer, also for spreadsheet use and word processing, although a production management software package for the Mac, Mac Quattro, is currently being considered by the production assistant for limited use. A total of twelve people interact with the computer system in the company, none of whom have been formally trained. However, they can and do operate the computers with ease. This fact has been attributed to both prior knowledge of computers and computer software, and the fact that all the packages used are very user friendly and mostly menu driven. Also in use is a Mac package for page layouts and page design and repagination, but as the company receives the page proofs already laid out there is little need for a page design tool in this case. Instead the company hopes to use the package for alterations and new contracts; it should be noted that the push for this package came from one of the print technology graduates. Printco A has invested approximately £100K in IT in the plant, and has adopted the view that innovation is a necessary tool in modern business and so reviews its' system regularly. Although the senior management wanted and introduced computers and software into the company, they do not have, nor wish to have, any first hand exposure to them.

Current Production Management System

The current production management system in Printco A is an amalgam of two primary systems. The first is a computerised system which was written especially for the company; the second is a manual system. The computer system was written for the company at the request of the general manager. He outlined to the software house exactly what he wanted in the package, and the

result was delivered and termed MASTERPRINT. The package included a stock control facility which was never used and is thus a redundant part of the package. The result was that the package was used for one purpose only - for the printing of works instruction tickets. A connected terminal exists in the stock room, but is not used for stock entries. The manual system has therefore to manage the scheduling, capacity planning, payroll, and stock control. The system for this, while effective, is non-procedurised and operated from 'peoples heads". The capacity planning and scheduling is carried out manually by the general manager by rule of thumb measure and mental historical analogy. This makes the general manager an indispensable link in the current management system. Scheduling of production is planned in a manual fashion by two people, using two books - a sheet of paper per machine, and using 18 hour shifts to plan production. The remaining stock control entails a physical stock count and the ongoing process uses invoicing to update the stock data. The company has recognised that the manual scheduling and control of the business is far too slow to be totally effective and that the increase in the company's' data requirements is pushing the present system to its limits. Printco A is therefore investigating the possibility of implementing a new production management system. If a new system is to be introduced, four people will be interfacing with the system on a regular basis; but no plans have been made concerning such issues as stock room terminals, etc. The system that was under consideration was the ISIS system KERIN - a print management package, but the project died just prior to confirmed selection and implementation. The company is now back to square one as regards the problem of system replacement.

3.4. Plasco A - Plastics Sector

Company Facts

The present owner founded Plasco A in his garage employing one person operating one 250 ton injection moulding machine. It now operates in over 20k sq. ft. it is operating twelve 60 to 350 ton injection moulding machines. Turnover has doubled from its 1980 levels to its present level, due to expansion into new markets.

Category	Estb.	Employment	Turnover	Environment	Quality
Two	1972	61	N/A	MTO	No standard

Table C.3.4 - Summary of Company Facts

Plasco A moulds the components required by the customer using the customer's moulding tools - the standard convention in a such a environment. There is some MTS carried out but this is only for one customer and involves Plasco A having to hold stock for up to 30 days. The company's product range is over 70 different items, ranging from toy figures for MB Games, medical cream containers for Johnson and Johnson, blasting cones for explosives in quarrying,

VDU frames, rear view mirror casings and mounts for Donnelley Mirrors, bathroom scales casings, and binding strips. It also has a emblem embossing facility, the ramifications of this embossing step means that the same moulding may be embossed with different information, and consequently have different stock numbers. Plasco A turns it's inventory only once a year, with supplier lead-times ranging from 3 to 4 weeks. Manufacturing lead-times can vary from 3-4 days to 6-8 weeks, while the tools are being designed, manufactured and set. The company supplies 75% of it's production to the domestic market, the remainder to overseas, with 25% of this figure being one product - a thin plastic binding strip moulded under licence from an American company.

Plasco A does not have ISO 9000, but is moving towards it and expects to have it in a few months time. Although it is not considering WCM, it is trying to introduce a form of TQM into the factory. The company operates SPC on one line of products because of customer insistence, with all information being automatically fed into a PC format transducer measuring station and checked against the operating tolerances. Quality testing to this degree is only carried out on this product, but more informal quality checks are carried out on all the other products from all the shifts. The company operates on a shift basis, 24 hours a day, 5 days a week; it also keeps the twelfth machine free from inclusion in the scheduling and capacity calculations, and uses it specifically as a tool warm-up facility or as an overflow machine if orders have pushed operations beyond capacity constraints.

Organisational Structure, Business Planning and Quality Practices

Plasco A has four levels of staff before the operator level is reached. Under the managing director comes the materials manager, the production manager, a QA department and an accounting department. Stores become the responsibility of the materials manager, with the supervisor under the production manager in charge of 3 sections; the moulding shop, the tool room and the printing/embossing and packaging. The quality manager has two inspectors working in his department. Plasco A does not have a specialised systems person and the responsibility has been adopted previously by the managing director, but currently by the production manager. The decision making process in Plasco A is becoming more democratic with a clearly defined delegation of authority in existence. The production manager feels that because of the 24 hour shift environment, coupled with the various levels of management between he and the operators, there has arisen a communication problem. The maximum planning horizon is two years and as a result of this Plasco A hasn't devised any formal long term goals or objectives. The company has no formal business plan. Plasco A has recently made use of the IDA grants for consultancy and has brought in outside consultants to review the company's operation.

Education

Of all the people involved in management in Plasco A, only the production manager has had formal training. He holds a degree and City and Guilds qualification in electrical engineering and a certificate in quality control. Three are embarking on night courses in Carlow RTC in areas such as SPC and TQM.

Some have also attended Eolas run courses in company specific areas. Education courses, where applicable, are encouraged for senior staff with time off and full financial aid. The company attends seminars given by the Plastics and Rubber Institute, the Irish Quality Association and other specific seminars, as well as subscribing to most of the major trade publications. All these magazines are freely circulated within the company. The average level of education of the operators is generally to intermediate certificate standard, with some leaving certificate holders also employed. There are no City and Guilds qualifications, nor are there any apprentices employed at present. The company would consider courses for employees in job specific areas and would meet the commitments of finance and time-off. When a new machine is acquired by the company, the training of the operator is generally always included in the deal, and where necessary the tool setter might travel to see the machine in operation in another company.

Current Levels of Information Technology

Currently in use in Plasco A is a Nixdorf Quattro 40 mini. To supplement this there are two PCs running word processing and some smaller packages. The total amount which the company has invested in IT is in the £30,000 region, and is constantly keeping the system under review. 10 people interact with the computer system and although on the smaller packages no training was offered

Current Production Management System

The company operates a computerised PMS running on the Nixdorf that had just been updated 18 months previous. It replaces an older Nixdorf system which had become obsolete and warranted the introduction of this new generation software. The selection of the system was the sole decision of the managing director. The software is an integrated system written by Nixdorf. The system interfaces with wages, accounts and stock control. Also included in the system is a MRP module and a capacity scheduling planner, although the MRP system is only used to 50% of its ability, according the production manager. The production is manually keyed into the system *after* it has been produced and this serves to update the stock situation automatically. The MRP module is used only for checking the stock usage situation, as the *real* figures are calculated manually in a virtually parallel process. The capacity planning and production planning modules are not used at present, the sole reason for this being that nobody knows how to use these aspects of the system. The company does however, envisage the use of these modules soon, although whether or not these modules will be exploited to their full potential is doubtful. To aid the introduction of these modules the company is considering getting in house training in again. Initially, Nixdorf trained three operators in-house on the system over a period of time when the new generation package was adopted by the company. This was included in the deal price and was confined to three users on the basis of these three then being in a position to educate the remaining users.

One of the major advantages of the new system is the backing up time of the current data; with the old system the average backup time was two hours, with the new it is five minutes. From what the production manager related the

company could exist without the computerised system, as the entire process is repeated manually. When the computer system stock records are checked against the monthly manual stock-take discrepancies are found to exist between the two, this has resulted in the system being regarded with suspicion, and consequently not trusted. It took one month to fully introduce the current system into Plasco A.

Scheduling, capacity planning, weekend overtime and sub-contracting are all aspects which are done manually be the production manager. Costing of runs and estimating are carried out by the accounts clerk/receptionist using information from the system and then costing manually. The company changed none of its style of operation since the adoption of the new system. There is one terminal in the stores for the storesman to check the stock with, although he does not have the ability to enter any data such as goods received onto the system. No other terminals exist on the floor, and there are no plans to introduce any in the future, nor does it have any plans to link it's CNC injection moulding machines with the system to log operating cycles and throughput.

3.5. Plasco B - Plastics Sector

Company Facts

Plasco B began originally as a 50/50 joint venture between Irish and American interests, that interest now being 80/20 American/Irish respectively. There has been a new owner of the American parent for the last 2 years, but the objectives and operating practices of the Irish operation are mainly independent of the U.S. parent. The company went through it's most dramatic stage of growth in 1988 when its turnover increased by 60%, however this was a short-lived surge due to a major IBM contract landed at that time. Since then the turnover has fallen back to its previous levels.

Category	Estb.	Employment	Turnover	Environment	Quality
Two	1980	185	£12 M	MTO	No standard

Table C.3.5 - Summary of Company Facts

Since the founding of the company, the number of operational machines has increased from 6 to 30 with an ongoing replacement programme. Employment levels have fluctuated over the years from a high in 1985 of 300+, to 250 in 1991, to the current level of 185, 38 staff and 143 operators. In the second plant (packing and film shielding) the employee levels range from 30 - 100, this figure being very much dependent on contract job requirements at the time. The plant still occupies the original building, with an expansion plan to include the second plant's operations on one site.

All the fluctuations in growth and rationalisation have been solely dependant on contracts received by the company and therefore all of the expansion programmes have been short term reactionary responses to the market. It is interesting to note that when the plant was being planned for by the parent in America 12 years ago, one of the main driving forces in its location, size and product range was the planned co-establishment of a product consuming multinational media storage manufacturing plant on the same site. The siting of this plant fell through after Plasco B went ahead, meaning that Plasco B had to quickly adapt to a changed market from the outset for survival.

Plasco B currently injection moulds 100 different components for its contract customers, with 150 active components in raw inventory. The procurement lead-times vary from 4 days for PVC to 3 months for a specialised resin, with moulding tools taking up to 2 months from ordering. Inventory is turned 14 times a year, with finished goods being delivered straight from the packaging and shielding departments. The company has not yet received ISO 9000, but expects to be awarded it soon, it is also looking into WCM. The main product range includes disk packs, the housings within which the computer hard disk drive is enclosed; the other main product are *Easyloads* - the magnetic tapes are loaded onto in mainframe computers. Other products include VDU and CPU cabinets, compact disc cases along with a lot of smaller computer hardware related mouldings. The export market consumes 70% of production, the majority of which is shipped to the U.K.

Organisational Structure, Business Planning and Quality Practices

The organisation structure has become flat after a deliberate company decision aimed at stripping out a level that had existed and had seen to be wieldy and unnecessary. Now, both the accountant and the clerks report from the same level and the QA supervisor has been replaced by a direct link from the QA manager to the QA inspectors. Production management still maintains the conventional supervisor/technician buffer, but communication has improved between the levels. The engineering department has two engineers and a newly acquired CAD station. There is no specialised systems person, one of the engineers looking after this to some degree. There are two production meeting held every day, and have served to eliminate a lot of the bureaucracy from decision making and have helped in the efficient delegation of authority. Due to the impending implementation of ISO 9000 defined procedures do exist. Plasco B's maximum planning horizon is12 month, with fire fighting more dominant than fire prevention. There is an informal strategic *thinking* approach planning rather than a *written* business plan, included in the strategic thought process are plan for expansion and consolidation of the second plant as described earlier.

Education

The Managing Director of Plasco B comes from a moulding background. The plant manager is a previous managing director of Gillette Ireland, and the materials manager was marketing manager prior to the reorganisation. In order

to convert from marketing to materials and purchasing, he was sent on an intensive two week managers course in Stanford University in California at the company's expense; the managing director had attended the same course. The technicians and engineers all came to the company educated in their areas. The company regularly receives and internally distributes trade related, technology and management journals. It is very active in the Plastics and Rubber Institute in Ireland and regularly hosts their seminars. It has sent several people along to IMI courses related to direct areas of interest, but finds it increasingly hard to allow time off in order to travel to Dublin where the majority of seminars and courses are held. The average level of education on the floor would be intermediate certificate, there are no City and Guilds qualified people at this level. In the case of education of any new machine acquired by the company the education would included in the purchase deal; including any site visits where the new machine would be in operation.

Current Levels of Information Technology

At present in the company is a Northstar network with 16 terminals, and an secondary network interfacing the remaining 7 PCs. The CAD system was acquired recently from a company going into liquidation. The CAD operator has not yet been trained, but there will be in the future. Also on the network are spreadsheet packages which are used for cash flow analysis and forecasting, and reports, a word processing package and other minor administrative packages. The training of personnel on these packages was not a consideration due to the existence of these skills before employment.

Current Production Management System

In use currently in Plasco B is an amalgam of programs which operate in a non-integrated fashion. For accounting purposes the company uses OMNICRON, which allows the use in a spreadsheet environment of cash flow simulations, sales analysis and report generation. The wages system is MACROPAY, which operates independent of the accounts system. OMNICORP (no connection to OMNICRON) is an Irish developed MRP package which the company does not exploit to its full potential, due to a lack of thorough understanding of the package. All the information is keyed into the system, i.e. the requirements for an order, and the application then generates a running stock tally. This has found to have reasonable accuracy against the manual stock take at the end of each month. Also used is a "basic cost control" package , which was developed within the U.S. parent company. This form of production and stock management has been in place for 5 years now, replacing a Nixdorf system (both hard and software) which was scraped due to the company's dissatisfaction with the system. For the replacement system the company paid £50,000. The budget allocated for the new system is in excess of £110,000.

There have been several reasons which have prompted the company to consider the adoption of a new, fully integrated system. Perhaps the most interesting, but not most crucial, is that of Apple's and IBM's desire for an integrated, operational EDI link into Plasco B's order process. This will also serve to allow Plasco B the ability to observe the customers requirements well in advance and thus allow more accurate forecasting and scheduling. Apple have asked that

this EDI link be operational soon, but as of yet have not specified a date. But most importantly is that Plasco B realised that it needed to cut out all the non-profit contributing activities within the company in order to hone a competitive edge, one avenue of attack was to eliminate the duplication of work which arose from the double keying of data into separate systems in order to arrive at the final output. The net result of the solution to this, Plasco B feels, will result in the redundancy of tasks currently performed, and so, ultimately the redundancy of the operators of these tasks. What Plasco B might find instead are more value added tasks else where in the plant as a result of the system.

Also needed, and not at present due to the non-integrated system, is more timely information on activities in the plant and order requirements. In choosing the system Plasco B has embarked on a non-structured plan of selection and implementation using consultants. This did not produce satisfactory results for Plasco B and so began to choose the system themselves, with two people reviewing the capabilities of each system, some in-house, others in installed sites, with the eventual aim to formally form an implementation team to carry out all the tasks necessary to implement successfully. In this it considers education of the operators of prime importance and in budgeting for around £20,000 for this task. It also plans to lease the system rather than purchase. It foresees no problems with user acceptance, although as stated earlier, it has resigned itself to the possibility redundancies. Plasco B is however confused as to how to approach the recording of production and operator clocking in and out. It is also looking to replace all the spreadsheets currently operating independent of each other.

3.6. Foodco B - Food Sector

Company Facts

In 1987, Foodco B underwent it's most dramatic phase of expansion with major shareholders, the directors and the IDA, acquiring a 25%, now £6%, stake in a large food company in the UK. Along with the acquisition of this company, Foodco B also opened two other manufacturing plants in Ireland to give a production floorspace of over 150K sq. ft. in Ireland. In 1989, due to a need for a large capital injection, the 25%, now 36%, of the company was acquired by a larger UK food multinational. This merger brought not only the needed capital, but also the technical resources and marketing contacts to expand and strengthen the company's market. As a result of this merger, Foodco B got control of the frozen food operation of another Irish food company owned by the UK food chain. The advantage of this was that Foodco B inherited a developed market brand and a developed distribution fleet, which Foodco B had lacked due to dealing purely with the major supermarket chains since 1987. Foodco B bought two further Irish companies over a three year period, and this year is opening new production and group headquarters in a greenfield plant.

Category	Estb.	Employment	Turnover	Environment	Quality
Two	1982	640	£65 M	MTO	No standard

Table C.3.6 - Summary of Company Facts

Foodco B manufactures pizzas, frozen processed fish, pies, and pancakes. The company is now developing "adult pizzas", with all of the groups produce being marketing under the one group brand name. Ingredients and packaging materials account for over 600 SKU. The supplier leadtimes are kept very short, due to the company policy of maintaining domestic suppliers to cut transport costs, and as a result holds very low stocks, operating a JIT practice. The maximum process leadtime from order receipt to order shipping, is within one week, although this is dependant on the nature of the customer order contract.

Organisational Structure, Business Planning and Quality Practices

The management structure of the company has been re-evaluated over the last 18 months, with an extra level of management added in. The first phase management consists of the directors, with the second phase management below including senior management, accountants and plant manager. The new level, or third phase management, consists of the newly promoted supervisors, technical engineers, and distribution personnel. The group financial controller reports to the group financial director, with a financial controller and accountant in each manufacturing base. there are weekly financial meetings and reports submitted to the financial committee. There is a low level of bureaucracy and task delegation is an area where they "are learning, and have to improve, coming from a situation where it was an owner manager to the present open system". There is both a formal distribution plan and marketing plan, spanning a 12 month period. This will soon be changing to a 3 year strategic plan that will be used as benchmark with 12 month budgets. The new plant being built, costing £22 M, was evaluated using a 7 year plan as a project. Formal long term goals just being developed, the first major goal being to reach a level of competence in the UK market, then expansion into Europe. Foodco B operates a R&D department covering areas including marketing people constantly visiting stores in the UK looking for improvements in packaging, taste, market segment, and new product line; also includes product development of new products and improvements to existing products, along with process improvements improving line speeds. Auditing for ISO 9000 is due soon, with the company striving towards to because they regard themselves as progressive with certain target customers that they would wish to do business with, they hope to use ISO 9000 is another marketing tool to achieve this. An important factor was traceability of the product, to be able to trace any quality problems back to the suppliers.

Education

All of senior and middle management have third level qualifications. Training courses encouraged only if it will benefit the business. At operator level, the

average standard would range from intermediate to leaving certificate. This has arisen from the company employing second level students as part-time staff on a half-shift basis, with some ultimately staying on. There are several formal education courses in operation in the company, including hygiene and quality programmes. The company tries to bring the training courses in-house to relate the training directly to Foodco B's operations, rather than personnel embarking on general external courses.

Current Levels of Information Technology

Foodco B has invested over £700K on its IT system. This includes hardware (£200K), software, consultancy, and man-hours. The majority of the functions run on standalone PCs, the prime package being Lotus 123. Recently they implemented the financial functions across the group on a Digital microVAX with a VAX based accounting application. This system was acquired through an Irish supplier that was contracted to upgrade the entire operations of the group. For the sales and distribution aspect the business uses a product called VANTAGE, with sales, stock, and a telesales function, with the orders dispatched down to the depot for loading and delivery. At present the Dublin depot is the only computerised depot, with Cork and Tuam coming on line soon. By start 1994 the company will have a fully computerised sales, marketing and distribution system. There is a high level of confidence in computerisation in the company, and while the directors don't use computers, they have no fear of them and regard them as a necessary tool. The distribution and packaging area were looking at the distribution problem of reducing the cost per unit delivered. In this investigation, they adopted and successfully use a software application called PALLET MASTER, which attempts to optimise the amount of cases per pallet, and thus pallets per container. The company is currently on a quest to discover a suite of packages will look after accounting and administration, linked into distribution and manufacturing.

Current Production Management System

The company current controls all of it's production costing and control based on Lotus 123 macros. The system is structured with a cost price group by supplier per product supplied, and the price per unit of purchase, the component price of any product being set at five decimal places. A weekly physical stock takes yields a definite inventory which is checked against the system generated figure (the opening stock plus receipts minus closing stock) - the resulting deviation is the variance, that will determine whether or not the line incurred a profit or a loss. With this very tight monitoring of the production line and material usage the generated reports, the responsibility of the plants performance is passed to the operators as much as to the management. The problem however with this system is that its operations are totally dependant on key people who understand the complexities of the macro structure. It was decided to begin to replace the accounting aspect of the company's operations first, as they were confident that they would succeed with it. On the manufacturing side, the company is looking for a system to handle it's process operations. The company decided to select a local successful supplier, as they rated system support as very important to system success. MAPICS and IMPCON were proposed as possible solutions, but not suitable for process environments,

consequently the American process package SIMPRO was selected, to run on the company's microVAX. This failed however, as major problems were encountered due to it's inability to carry out the basics such as transaction registering for stock movement. As it didn't meet the standards, it was then scrapped. The company recognises now that it should have spent a lot more time specifying and analysing their operations.

As the selection and implementation was driven by accounting personnel, it is now recognised that the production department should have been involved sooner and given much more input. A timetable was drawn up by supplier and company, and a full CBA carried out. What would be wanted form the new system would be to put the production and stock information back onto the factory floor rather than send it all back to accounts and then returned to the floor. Raw material inventory control, purchasing, cost price issues, and variance analysis all need to be in through the production package according to the company. With this system in place the move to a MRP situation for process planning and production planning could occur. When they approach it again, they would now get someone that had "been through the mill and knew what could go wrong". They feel that the way to approach the implementation is to prioritise the individual projects, with minor goals en route. With specification of the individual projects, along with heavy involvement of the plant manufacturing manager and the establishment of manufacturing steering committee with a project team in each plant consisting of the plant manager, the accountant, and MIS/technical resource personnel. The objective this time would be to select or devise a standard system that could implemented at any of the groups plants or even into a greenfield site. While consultants were used during the implementation of SIMPRO, they involved only accountanting and no production personnel as stated earlier. Foodco B felt that the use of consultants is good at the strategy level, but not so good at the implementation level - 'they bring an approach, steps to be carried out, but they won't roll up their sleeves". As recounted by the group financial controller - "we are dealing with the heart of the business, a key area, and having burnt our fingers once - we're going to get it right the second time".

4. CATEGORY 3 COMPANIES - OPERATIONAL PMS

4.1. Fabco C - Metal Fabrication Sector

Company Facts

Operations began in Ireland in 1976 as the Irish manufacturing base of an English steel company. In the early eighties, a management buyout resulted in a fully owned Irish company, until 1989 when following an IDA suggestion, a larger company aquired Fabco C . The reason for this sale was the fact that the Irish operations where too financially stretched to expand any further, and under larger ownership the company's labour force and floor space has doubled.

Fabco C is a sheet metal MTO operation, its product range including hardware skins, brackets, main frames, and ventilated stacks for the computer and medical industries. Raw material stocks number over 3,000 individual items and maximum manufacturing lead time is five weeks, with supplier lead times ranging from two to three weeks. Fabco C supplies 14 customers, the majority being domestic, of which five would account for the majority of business.

Category	Estb.	Employment	Turnover	Environment	Quality
Three	1986	150	N/A	MTO	ISO 9002

Table C.4.1 - Summary of Company Facts

Organisational Structure, Business Planning and Quality Practices
ISO 9002 was awarded in 1989 and the company is looking towards WCM. As all of the products are MTO, there is no research and design facility. The management structure of Fabco C is flat, with two joint managing directors, one in charge of sales and marketing, the other looking after all other functions. Decision making is heavily bureaucratic, with particular attention given to operator input in most major decisions. Operating procedures are clearly defined, as within ISO 9002 guidelines. Fabco C has a formal business plan, and is one year in to it's five year plan.

Education
The general manager has a MBA, with several other managers having regularly attending IMI, or similar courses. Three graduate engineers are employed and the company has a policy of encouraging management education and seminar attendance. The dominant level of education of the floor staff is intermediate certificate, with no formal policy existing for operator education.

Current Levels of Information Technology
Total expenditure on I.T. in the company is estimated at £120,000, consisting of a PC network running a word processor, a database, spreadsheets, two CAD systems - one each for engineering and electronics, and the PMS. The generation of hardware has been constantly updated since the companies formation with no total replacement. 20% of the company's employees interact with the system and training was handled in house, with no problems encountered.

Current Production Management System
The production management system that has been in use for one year in Fabco C is a modular system called MICROSS. It is not fully operational yet but is "gradually being absorbed into the company". The factors influencing the introduction of a system were:

1. customer pressure,
2. company expansion,
3. parent company pressure

leading to MICROSS being adopted after a six month search for a system with the help of a consultant. Both Fabco C and the parent company justified in advance the capital outlay and the long implementation lead time for the system to become fully operational. The MRP facility is not in use, but the remainder can handle all of the company's requirements and is found flexible enough to cope with their operations. There is only one terminal on the floor, in the stores area, and no plans to add any more; this according to the operations manager is because he doesn't 'believe in giving too much information to the operators on the floor, as the would only perform jobs out of sequence". The company accepted the hours needed for the education of those interfacing with the system and would now find it "hearly impossible" to operate without the system.

4.2. Printco B - Printing Sector

Company Facts
Printco B remains under management control of the current managing director, who founded the company in 1977. The addition of new stockholders in 1990 injected equity into the company, causing the most dramatic stage in the company's growth. The effect of this has been the ability of the company to expand their operation with the aid of the extra capital. Printco B's main product range includes machine control panels templates, nameplates, decals, templates and transfers, and the manufacture of membranes for the production of the range above. Up to 60 different products are held in stock, valued at £100,000, and turned 6 to 8 times a year. The printing lead-time for their products range from 8 to 20 days, with a maximum supplier lead-time of 6-8 weeks for bulk PVC powdered polymer. 75% of production is for the domestic market, and all to manufacturers.

Category	Estb.	Employment	Turnover	Environment	Quality
Three	1977	95	£3.1 M	MTO & MTS	ISO 9000

Table C.4.2 - Summary of Company Facts

The main mode of operation is MTO operating a small volume, quick turnaround philosophy with up to 70% of production having a maximum lot size of 400 units; the company does practice some MTS production. The bulk of the profits are invested as capital expenditure within the company with £200K being allocated for equipment last year, twice this being invested in IT the previous year.

Organisational Structure, Business Planning and Quality Practices
The management structure of Printco B is predominantly flat, with the managing director reporting to the board of directors. There is a specialised systems engineer, who works hand-in-hand with a part time consultant on the

company's IT system. Decision making in the company is not terribly bureaucratic, with free, open communication and input channels in existence with a clear delegation of authority. Because of ISO 9000, operations procedures do exist in the company. Teams represent the interests and views of operators during any major policy changes or operational decisions. Where the delegation of authority is best used in Printco B is in the situation of setting targets and allocating responsibilities at the production meetings which take place every morning chaired by the operations director. The company has several very specific strategic goals in their five year business plan; the main goals being to develop and expand into new markets for its products, particularly the UK and Holland with a more "clear cut product range" - developing two main products in the same customer base. It also hopes to double current employment levels. The company has had ISO 9000 since 1987, and is at present considering WCM - "certainly externally, maybe internally".

Education

At management level in Printco B, education courses actively encouraged, and one of the manager holds a MBA, several others regularly attending IMI, APICS and quality courses. A library has been established in the company consisting of all relevant journals and publications; the entire workforce are encouraged to use this facility within factory hours. Training of the staff to use IT in the company is carried out by the MIS engineer and has developed into a formalised programme. Training of the staff who interact with the company's IT system is carried out in a very well structured fashion, with the MIS engineer arranging monthly courses for all system users. The format of these courses is one where all the users sit down at terminals in the company board room the entire system is slowly gone through. When a problem is reached, action may then be taken in clarifying or editing the problem area. Also if the users feel that a particular screen is too cluttered or not specific enough, the MIS engineer act on their suggestions and make the according changes. The average education level of the operators on the floor was intermediate certificate level, but this has risen to leaving certificate level in the past two years. Part time courses and night courses are encouraged with full financial compensation. Every Monday mornings for one hour classes given by senior managers are held on the issue of quality and full attendance is mandatory. The company also promotes everyone to take Apple Macintoshes home to built a fuller understanding of computers. This is the part of a pilot plan to instigate a formal in-house training programme on the use and implementation of the Apple Macs. When Printco B acquires a new machine the supplier is responsible for the education of the operators and the company generally pays for a key operators to visit a site where a similar machine would be in operation.

Current Levels of Information Technology

Printco B operates both stand-alone PCs and a PC network, a microVAX 3100 with 17 dumb terminals (expanding to 64 terminal capability), and an network of Apple Macs, collectively linked via Pathworks. The company has invested under £500K in IT on hardware and software implemented by the MIS engineer and a part-time consultant. The present system has been in use for eighteen months now and is constantly reviewed for the possibility of upgrading. All of

the admin. staff interact with the computer system and have thus become very aware of the systems input to the operation of the company; few floor operators interact often with the system. The software that the company runs, apart from its PMS, includes MacWrite, Excel spreadsheet, and a VAX based accounting package, called SuperAcc.

Current Production Management System

Initially in the 1980/82 there was only one PC operating a very basic system, to this two Apricot F1s were added running spreadsheet based applications. Between 1983 & 85, three Apple IIs were introduced, and the company was still using hand written works tickets. The turning point in highlighting the need for a system came in 1985 when one of their major customers began to demand high quality standards and encourage ISO 9000 levels, also needed to respond quicker to customer orders. The company was therefore forced to analyse their quality system and the net result was the recommendation for a formal computerised production management system and the necessary investment. The company invested the profits from the 1990 financial year in system introduction as a capital investment, and so the amount spent was significantly affected by the profitability if the company. Because the funding was allocated as a capital investment, the company expects payback from the system to recoup the expense. It does, however, realise that it may be difficult to quantify the payback of the system for this purpose. Thus in 1987 the company acquired its first mini, a Micro VAX 2, and began to run spreadsheets. The estimator was sent on a course to Digital at the company's expense to familiarise himself with the VAX system. IMPCON was then introduced. As there was no real experience in the company of CPMS, the company accepted the system blindly, and finally in 1989 "after every imaginable problem"- decided to scrap the system and move on. Currently in use in the company since 1989 is a print management package called KEREN, developed by ISIS. A special arrangement was reached that in return for getting the package and service and a low rate, the company would used as a working example of the new package. KEREN was thus implemented and attempts were made to get the company fully integrated. Several problems arose in the integration process, with the supplier pulling out and resulting with Printco B being without an Irish based service agent and thus all development and rewriting had to been carried on in-house.

The first stage of system introduction was estimation, job costing, and works tickets modules of the system. The existence of two tiered figures in the system; i.e. the sales order entry system was yielding a different set of figures than the invoicing system, due to such factors as customer discounts, caused problems, but this was tackled by the company writing a 4GL procedure and integrating it with KEREN. The MIS engineer is also looking to develop a MRP facility to integrate with the system, and is actively encouraging an email system. 22 people use the system and also coupled into the system are the 24 Apple Macs that are interfacing with the VAX by means of Pathworks software. This further increases access to the system by a further 30-40 users. The package is flexible enough for the company, with tailoring and integration of secondary packages being carried out by the MIS department. The areas that

the system is particularly weak in is the production recording area, but this is more due to under-exploitation by the users than the actual system, however the purchasing module of the system is not sufficient to meet the company's requirements and is simply holding back the overall efficiency of the company. The system's stock facility performs quite well handling both raw and finished stocks. The system is rigorously adhered to and no manual backup is operated by the company; the company would not change the system in any way and would recommend it as a print CPMS. It has:

1. increased capacity due to the increased turnaround of jobs.
2. noticeably reduced storage inventory because of greater visibility of requirements.
3. reduced the amount of paperwork needed to process a job.
4. removed an entire ordering step to give a more rapid customer order confirmation response time.
5. given greater visibility of stock requirements, and improved feedback from production.
6. redefined the personnel job specification to a more efficient clerical system.

The company now is ready to finish the implementation of the system, and so to exploit the system to it's full potential. While it has not taken long to establish confidence in the system as a whole, there are some aspects of the system that not running efficiently and need more work; however the company is prepared to wait, recognising the long lead-times required for some systems full integration. The MIS department is expecting full implementation to be achieved with a year.

4.3. Printco C - Printing Sector

Company Facts

Printco C was originally founded in 1804. In 1977 it was acquired by Printco C. Ten years ago the company was losing money dramatically, but by 1985 the company turned to profit. Since then throughput has increased to 35 tonnes of books per day, 5 small printing presses replaced with six large new printing presses, one of which is a newly acquired £3 million web press, which will increase the throughput of the entire company by 50% in the printing and binding areas.

Category	Estb.	Employment	Turnover	Environment	Quality
Three	1977	170	£11 M	MTO	ISO 9002

Table C.4.3 - Summary of Company Facts

On any one job there would be seven components - alcohol, inks, blankets, paper, cover board, glue, and stitching wire. The shortest procurement lead-

time for the paper is two hours from the stores in Drogheda, but the actual order is placed a minimum of a month in advance from the mill in Germany. The company holds one days supply of paper in the factory. While virtually all of the business Printco C does is for domestic customers, the vast bulk of it's produce is for the export market. One of it's main customers ships all of it's printed manuals to the export market. Stock is turned every two weeks. The lot sizes are determined by the EOQ from the purchasing and estimating department, and the EOQ values have been steadily decreasing over the years. It also operates on an EOQ system to govern production runs, delivering to the customer on the same day, the average run is approx. 10K books

Organisational Structure, Business Planning and Quality Practices

The organisational structure for Printco C is flat, with all areas reporting directly to the managing director, who regularly walks the floor to observe operations. Each of the four sub-managers have two supervisors to oversee production. The company prides itself on it's communication links between staff and the floor, and all managers are encouraged to regularly tour the shop floor for feedback keeping communication channels open. This has been a very deliberate policy in the company and has been working for a long time to bridge the gap between operators and staff, one method being the clocking in and out of all employees from the managing director down. The company relies on the effective delegation of authority to ensure performance and would not regard itself as a very bureaucratic operation. Printco C's furthest planning horizon is five years, with all it's goals stated in its business plan. The company's approach to management is one of "management by objective", and as a result the company finds that it's short term goals are indicative of it's longer term goals. The company has had ISO 9002 since 1987. It also has the Quality Mark and several ship-to-stock certificates. The company regards itself as the leader in WCM in the printing industry in Ireland, concentrating its WCM effort in five main areas: Total Quality Control, Total Preventative Maintenance, Simplicity, Employee involvement, and JIT principles. The company regards the implementation of WCM as a success, with every employee aware of all five principals involved.

Education

The managing director is an accountant by profession. External management training courses are not *discouraged,* but are not openly promoted as the Irish corporate parent regularly organises management training courses. The company claims to have spent quite a deal of money in educating employees on the elements of WCM, regarding itself as taking education very seriously. When computer operators feel the need to attend a course based on a new software package, the company would allow time off and financial aid. The company is presently trying to bring the company up to levels required by the 1989 Health, Safety and Welfare Act, this has meant a lot of training including manual handling training, safety training, and awareness training. They have sent safety representatives on courses, they have trained some instructors in-house. The average level of education on the floor is intermediate certificate level. The company maintains it has a very serious approach towards training and education of operators. There is an apprenticeship programme in place in

Printco C whereby all of the company's printers employed undergo or have undergone four years of study. If management were approached by an operator with a request for a training course, the company would review that employee's punctuality, contribution to the company, attitude, how well the employee will exploit and use the course. In the case of the new web press that the company recently acquired, the operators were taken off the floor for the last two months for training and have been brought to see the machine working in other companies abroad before the machine was even imported into the country.

Current Levels of Information Technology
In use in the company is a VS Wang network with 10 terminals, and several stand alone PCs. The software running on the network includes spreadsheets and accountancy packages, and the production management package.

Current Production Management System
Printco C currently operates a formal computerised production management system. An item is received into stock and is entered into the system. When a shipment is leaves the factory, the stock is automatically deducted from the stock records by the delivery dockets, which are printed out from the system, as are the invoices. The system provides opening and closing stock balances every week. At the start of every week the call-offs for that week are displayed and the system then calculates what has to be produced and in what quantity to satisfy customer demand. This information generated by the system is keyed into the PCs, which are used to schedule the jobs. The system is therefore used to amass all the critical information and the PC to schedule and plan capacity. The system can automatically raise a purchase order, but instead a kanban system in operation which uses visible red lines as the visual indication for stock replenishment. The current system has been in use for six months now, and the main factors of resistance to it's introduction were:

- Sacrificing the time to making the system work,
- A lack of understanding or knowledge of the capabilities of the system,
- A failure to see "the light at the end of the tunnel".

These issues were addressed by approaching the introduction of the system as a mandate that *had* to happen, and thus everyone *had* to ensure it's success. Ten users interface on a regular basis with the system. The key people involved in the implementation were "a select few", - stores, planning, and in-house computer departments, who were all involved from the conceptual stage through to the final testing phase.

4.4. Foodco C - Food Sector

Company Facts
Foodco C was formed 50 years ago as a family business. In 1988 the current managing director acquired total control of the company and doubled both

turnover and employee numbers. The product range of Foodco C can be divided into two main areas: one including cereals, rusk and coating, the other including seasonings, herbs and spices, with custom orders accounting for over 400 different mixes, or "recipes" (95% of the company's business). The operations of the company are split between the manufacturing site in West, and the direct retailing operation in Dublin dealing directly with customers food companies. Foodco C holds over 150 SKUs.

Category	Estb.	Employment	Turnover	Environment	Quality
Three	1943	33	£10 M	MTO	No standard

Table C.4.4 - Summary of Company Facts

The longest supplier leadtime is 6 weeks, with the process having a 48 hour maximum turnaround, the average being 5 hours. One of the products is always held in stock, so orders can be satisfied immediately. The company meets regular constant orders with constant customers, and as a result does not operate a long term order horizon. Of these customers, 70% are foreign based clients, with Foodco C satisfying an annual 50K ton UK rusk market and a domestic 4K capacity market.

Organisational Structure, Business Planning and Quality Practices

The organisational structure in Foodco C is flat as it is a "team game with no bosses". Each person is given a specific area of responsibility with seven department managers reporting directly to the managing director. there is a very low level of bureaucracy, with a lot of task delegation. There are three specific areas in the plant: blending and mixing, baking, and wholesaling, each controlled by a manager taking care of the entire individual operations. The company has a flexible strategy, with both 3 and 5 year formal business plans. One of the long term goals is that of geographical spread. The company has acquired business presence in Northern Ireland, and is currently acquiring a manufacturing presence in mainland UK to exploit the European market. While Foodco C is presently supplying traditional products, a second goal is to develop, manufacture and supply proteins, batters and new market products. The company is looking to develop a high value product over time, a move away from the current line. The company is now looking to strengthen it's existing market - "we were looking at them (Irish Republic and the UK) as two separate markets which was crazy...with devaluation, I very nearly moved the entire operation to England". Foodco C is striving towards ISO 9000, considering operator input "extremely important" in the formalisation of procedures, maintaining good open communication between people. "There has to be (open communication) if you're going to improve business, with little errors and mistakes if the operator doesn't report them to his supervisor we're in trouble", adding to this the company maintains a policy of "honesty is rewarded and dishonesty is disrewarded by being fired - it's as simple as that, I don't mind anybody making a mistake as long they report it".

Education

The managing director had been in the milling industry for 20 years, successfully computerised a previous mill. The rest of the managers are a "mixture of university of life and university graduates". The company encourages company relevant courses, especially in international business, reflecting the company's business goal - 'if we don't export we're dead, it's vital". Currently employed are meat science graduates, with Foodco C maintaining links with the awarding college. The company is now more inclined to employ professionals or graduates, whereas in the past they would have opted for non-trained personnel. This dramatic is reflected in the managing directors comment - 'Our business is not about the type of product we produce any more, it is about the technology we use and the research and development behind it that matters". Operator training has recently begun, due to the formalisation of standards and the ISO 9000 drive. In-house courses are held regularly during the year, given by contract professionals. Foodco C encourages flexibility, with operators who can perform other jobs but specialise in one particular area then move around within the plant to prevent boredom with any one job. Subscription to journals is maintained, as is membership of trade associations, with mangers regularly attending the UK and also European association meetings in Brussels

Current Levels of Information Technology

Foodco C has a total investment of £32K. The non-PMS software in use consists of a word processor and Lotus spreadsheets being run on networked PC's. The majority of accounting functions is carried out on the OMNICROM production management system.

Current Production Management System

The decision to introduce the current PMS into the company came at a time when the entire plant was undergoing a full modernisation programme. While the managing director was happy with old system, when a full time accountant was employed 'new snags were brought to light and it was decided that a total replacement would be the best route." This coupled with the old system hanging in the Dublin office and an immediate solution needed. The first system was a non-integrated system with no stock control function, that ran on an Olivetti interfaced by two dumb terminals. Upon failure of the system, the company became to realise the importance of the system supplier as they received little help in fixing the system. When the system did fail the first major change was to a new supplier. Of the two final choices, the ultimate decision came down for the less superior system, but the most impressive service support; also the fact that the supplier had introduced a system into a similar environment and so had prior knowledge and experience of the food industry. With pressure to implement a new system due to the company operating without accounts, OMNICRON was selected.

The initial specification was based on the existing system with additional capabilities. The system supplier liased with the production department to evaluate exactly what the requirements were and then tailored the system. The retention of some of the existing system operations lessened the shock of the introduction of a entirely new operational procedures. Seven of the staff use

the system and training was carried out on the new system by the supplier, taking key personnel and training them on a need to know basis, with the accountant being trained on the system in it's entirety. EDI was not regarded in the selection criteria as an immediate need, but it was acknowledged as a future requirement. Bar-coding was discounted as it was felt that this was only needed for a more homogeneous product range. At present neither MRP nor production planning are used. A budget of between £30 and 40K was allocated for the new system to 'bring the whole thing up to scratch." The accountant was given "carte blanche" by the managing director to select and implement the new system, once it was not going to change either the style or content of the data that he was receiving on his desk. It was accepted that the new system would take time to implement and six months were given as the implementation horizon of the immediate accounting and customer order functions. It still however 'heeds are a few more months to bed it down". The major implementation problem that was encountered was that the output of old system was still wanted, this was not considered in the initial specification, and so the motivation wasn't there with operators regarded it is as the accountants system rather than the company's system. This was solved by the customising of the system to deliver old style output. Also due to the speed of the implementation, less people participated than was wanted. Because it was implemented in the Dublin office first, the production plant benefited as it was able to learn quicker, and while it has altered people jobs, it hopes to exploit their time liberated by the system's introduction. The managing director holds the view that computers are an aid, but that they shouldn't run the business, he also has very little faith in computers, although he recognises that they do give him relevant and current information. He holds a very poor view of consultants, but admits that he would use them for a similar project again.

APPENDIX D

SELECTED SURVEY RESULTS

CAD	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
In use	28.6	2	53.3	8	50	2	46.2	12
By next year								
Within 5 years			6.7	1	25	1	7.7	2
Considering	42.9	3	26.7	4			26.9	7
Never	28.6	2	13.3	2	25	1	19.2	5

Table D1 - Use of CAD in the surveyed companies

CAM	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
In use	0	0	20	3	0	0	12.5	3
By next year	0	0	6.7	1	0	0	4.2	1
Within 5 years	16.7	1	26.7	4	0	0	20.8	5
Considering	66.7	4	33.3	5	33	1	41.7	10
Never	16.7	1	13.3	2	66	2	20.8	5

Table D2 - Use of CAM in the surveyed companies

MRP	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
In use	14.3	1	58.8	10	50	2	46.4	13
By next year	14.3	1	29.4	5			21.4	6
Within 5 years	14.3	1			25	1	7.1	2
Considering	57.1	4	11.8	2	25	1	25	7
Never								

Table D3 - Use of MRP in the surveyed companies

DRP	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
In use	16.7	1	13.3	2	25	1	16	4
By next year	0	0	20	3	0	0	12	3
Within 5 years	16.7	1	20	3	0	0	16	4
Considering	66.7	4	6.7	1	50	2	28	7
Never	0	0	40	6	25	1	28	7

Table D4 - Use of DRP in the surveyed companies

CRP	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
In use	14.3	1	53.3	8	50	3	42.3	11
By next year	14.3	1	20	3	0	0	15.4	4
Within 5 years	0	0	0	0	0	0	0	0
Considering	57.1	4	26.7	4	25	1	34.6	9
Never	14.3	1	0	0	25	1	7.7	2

Table D5 - Use of CRP in the surveyed companies

PAC	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
In use	14.3	1	4.9	6	66	2	37.5	9
By next year	14.3	1	28.6	4	0	0	20.8	5
Within 5 years	0	0	14.3	2	0	0	8.3	2
Considering	42.9	3	14.3	2	0	0	20.8	5
Never	28.6	2	0	0	33	1	12.5	3

Table D6 - Use of PAC in the surveyed companies

MRP II	Category 1		Category 2		Category 3		Total	
	%	No.	%	No.	%	No.	%	No.
In use	0		7.7	1	33	1	9.1	2
By next year	16.7	1	15.4	2	0	0	13.6	3
Within 5 years	16.7	1	30.8	4	0	0	22.7	5
Considering	33.3	2	30.8	4	33	1	31.8	7
Never	33.3	2	15.4	2	33	1	22.7	5

Table D7 - Use of MRP II in the surveyed companies

Barrier	1st	2nd	3rd	4th	5th	6th
Top management not convinced of need	3					
Middle management not convinced of need		1				
Too much capital involved		2				
Implementation horizon too long	1					
Lack of faith in computers			1		1	
Selection of systems too great			1			
No need to change from present methods			2			
System not considered strategically important		1		1	1	
Other		1				

Table D8 - Category One Companies' Ranking of Barriers to PMS Introduction into their Operations

Barrier	Category 2 & 3	
	%	No.
Not enough information on system	11.5	3
Poor system documentation	7.7	2
Poor system support from software company	4	1
Floor operators not convinced of need	11	3
Users not sufficiently educated on system	7.7	2
Lack of understanding of computers	3.7	1
Company never effectively plans projects	3.7	1
Company not trusting of the system	7.7	2
Low knowledge of production management	7.7	2
Other	4	1

Table D9 - First Choice Barriers to Effective PMS Usage in Category Two and Three Companies

Barrier	1st	2nd	3rd	4th	5th	6th
Not enough information on system	3	1			1	2
Poor system documentation	2	2	1	1		
Poor system support from software company	1	3	1			
Floor operators not convinced of need	3		1	2	2	
Users not sufficiently educated on system	2	1	4	3	1	1
Company misunderstands it's own needs		2	2	1		
Company misunderstands departments needs			4	1	2	
Lack of understanding of computers	1	2	1	2	1	1
Company never effectively plans projects	1	1	1	1	2	1
Company not trusting of the system	2	1				2
Previous system still in use with new system		2	1	1		1
Low knowledge of production management	2	2		1	1	2
Other	1	1				

Table D10 - Category Two and Three Companies' Ranking of Barriers to the Effective Usage of PMS in their Companies

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